InstruTech, Inc.

InstruTech Quick Product Overview

Model	Vacuum Gauge Type	Measurement Range	Controller	Display	Display Units	Analogue Output	Set Point Relays	Digital Communications
IGM401 "Hornet"	Miniature Ionization	1 x 10-9 to 5 x 10-2 Torr 1.3 x 10-9 to 6.7 x 10-2 mbar 1.3 x 10-7 to 6.7 Pa	Built-in	1 Channel OLED	Torr, mBar, Pa	1	1	RS485
IGM402 "Hornet"	Miniature Ionization with Dual Convection - Operates one built-in Ionization gauge and two Convection gauges	1 x 10-9 to 1000 Torr 1.3 x 10-9 to 1333 mbar 1.3 x 10-7 Pa to 133 KPa	Built-in	3 Channel OLED	Torr, mBar, Pa	3	3	RS485
B-RAX 3000/3100	Multi-Gauge Controller Operates one InstruTech IGM-400 Ionization gauge and two Convection gauges.	1 x 10-9 to 1000 Torr 1.3 x 10-9 to 1333 mbar 1.3 x 10-7 Pa to 133 KPa	Rack or Panel mount	3 Channel OLED	Torr, mBar, Pa	1 (B-RAX 3100)	3	none
CVM211 "Stinger"	Convection Module	1 x 10-4 to 1000 Torr 1 x 10-4 to 1333 mbar 1 x 10-2 Pa to 133 KPa	Built-in	1 Channel LED	Torr/mTorr, Bar/mBar, Pa	1	1	none
CVM201 "Super Bee"	Convection Module	1 x 10-4 to 1000 Torr 1 x 10-4 to 1333 mbar 1 x 10-2 Pa to 133 KPa	Built-in	1 Channel LCD	Torr/mTorr, Bar/mBar, Pa	1	2	RS485 + RS232
VGC301 Controller	Convection Gauge Controller	1 x 10-4 to 1000 Torr 1 x 10-4 to 1333 mbar 1 x 10-2 Pa to 133 KPa	Rack or Panel mount	1 Channel LCD	Torr/mTorr, Bar/mBar, Pa	1	2	RS485 + RS232
CVG101 "Worker Bee"	Convection Gauge Tube	1 x 10-4 to 1000 Torr 1 x 10-4 to 1333 mbar 1 x 10-2 Pa to 133 KPa	N/A Connects to VGC301 Controller or existing Granville Phillips Controller	N/A	N/A	None Sensor only	none	none

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Bright Ideas for Science

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InstruTech, Inc.

IGM-401 Hornet
Miniature-Ionization Vacuum Gauge Module

Wide measurement range
1×10^{-9} to 5×10^{-2} Torr
1.3×10^{-9} to 6.7×10^{-2} mbar
1.3×10^{-7} to 6.7 Pa

Dual Hot Filament design Rugged and compact metal construction.

Built-in digital display, RS-485 digital interface, set-point relay and log-linear analog output, are all included in the standard Hornet module.

Bright yellow organic LED graphical display allows easy viewing from a wide viewing angle.

Also a Low cost, direct drop-in plug-compatible replacement for the Granville Phillips Micro-Ion® module.

Significant savings for you. Use your existing hardware, cables, and software. No changes to your process.

InstruTech IG Gauges

The IGM-401 Miniature-Ionization vacuum gauge module provides the basic signal conditioning required to turn the gauge into a complete measuring instrument.

The IGM-401 gauge tube assembly is constructed of a compact all metal design with dual Yttria coated Iridium or optional dual Tungsten filaments.

InstruTech IGM-401 "Hornet" Modules

The built-in Controller is offered with a standard bright OLED display providing a convenient user interface for setup and operation of the vacuum gauge.

The emission current can be set to automatically switch between 4 ma and 100 uA. This results in optimal and stable pressure readings over the entire measurement range from rough to high vacuum.

Lower cost without sacrificing quality or functionality

InstruTech has made numerous design enhancements to reduce cost and improve performance. The electrometer auto zeroes to ensure that the readings are not subject to temperature drift. This eliminates the need for unnecessary and expensive circuitry which further reduces the cost. The extremely bright, crisp OLED display increases functionality and ease of use.

Service screens can diagnose filament problems and monitor the filament life.

Setpoint relay can be manually toggled to test for correct wiring.

Warnings will be displayed for all fault conditions

Filament current, emission current, and ion current can be monitored in real time on the research screen. Sensitivity and degas time can be user adjusted.

The display enables the user to select from 16 common gases without having to apply manual correction factors.

The gauge sensor assembly can be easily replaced in the field by simply removing four socket head cap screws.

Dual Yttria Coated filaments are offered for general vacuum applications. The optional dual Tungsten filaments are available for use in applications not compatible with Yttria filaments such as those gases containing chlorine, fluorine, etc.

Direct drop-in plug-compatible replacement for the GP Micro-Ion®

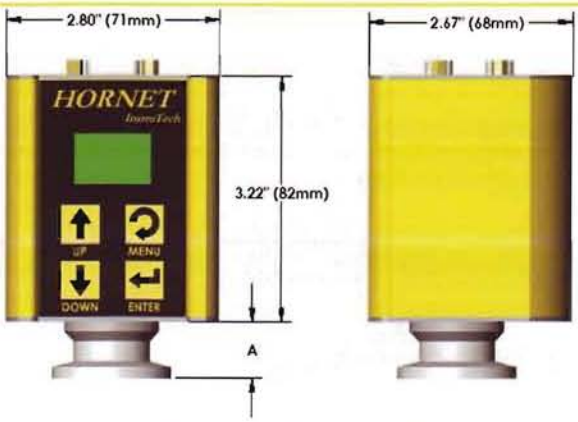
The IGM-401 module will also directly replace 2 different Granville Phillips Micro-Ion® modules. The InstruTech gauge provides equivalent or better performance throughout the range of 1×10^{-9} to 5×10^{-2} Torr.

One analog output, one setpoint relay and RS-485 digital communications are all included in the IGM-401. All are identical to their corresponding Micro-Ion® functions. Software commands are the same when using the RS-485 digital communication.

Specifications

measurement range (signal)	1 x 10^{-9} to 5 x 10^{-2} Torr / 1.3 x 10^{-9} to 6.7 x 10^{-2} mBar / 1.3 x 10^{-7} to 6.7 Pa
display	OLED Graphical Display, 3 digits plus 2 digits exponent, bright yellow
materials exposed to gases	Dual Filaments: Yttria Coated Iridium or optional Tungsten Ion Collector: Tungsten Grid: Tantalum Others: 316/304 SS, Glass, Nickel
sensitivity	Factory pre-set. Also user adjustable between 2 to 99 using the display
X ray limit	< 5 x10^{-10}
emission current	100 uA, 4 mA, or automatic switching between 100 uA and 4 mA
degas	4 Watts e-beam
overpressure protection	Gauge turns off at factory default setting of 5 X 10^{-2} Torr
internal gauge volume	1.0 in^3 (16.4 cm^3)
operating temperature	0 to + 40° C
bakeout temperature	200° C (sensor only - electronics removed)
humidity	0 to 95% RH non-condensing
weight	0.6 Lbs (0.27 kg) with NW25 KF flange
mounting Orientation	Any
digital Interface	RS-485
output signals	
analog Output	Log-linear 0 to 9 Vdc, 1V/decade
filament & Degas	Degas & Filament on/off status are determined by an open collector transistor or via RS-485 digital communications protocol
setpoint relay adjustment	Single-pole, double-throw (SPDT), 1A at 30 Vdc resistive, or ac non-inductive Adjust value using the display menu push buttons or RS-485 commands
input signal	Degas and Filament on/off & emission current are set by continuity to ground , via RS-485 commands or using the display menu push buttons.
filament selection	User selectable between filament 1 or 2 using the display menu push buttons or via RS-485 commands
input power	20 to 28 Vdc, 14 W
RF/EMI protection	CE compliant

Fitting	dimension A
NW16KF	1.45" (37mm)
NW25KF	1.45" (37mm)
NW40KF	1.45" (37mm)
1-1/3" Mini CF	1.85" (47 mm)
2-3/4" Conflat®	1.70" (43 mm)



Ordering Information Part Numbers

InstruTech IGM-401 Module -Fitting	With Yttria Filaments	With Tungsten Filaments	Replacement Sensor - Yttria	Replacement Sensor - Tungsten
NW16KF	IGM 401 Y B D	IGM 401 T B D	IG4YB	IG4TB
NW25KF	IGM 401 Y C D	IGM 401 T C D	IG4YC	IG4TC
NW40KF	IGM 401 Y D D	IGM 401 T D D	IG4YD	IG4TD
1-1/3"Mini-CF/NW16CF Mini-Conflat®	IGM 401 Y E D	IGM 401 T E D	IG4YE	IG4TE
2-3/4" CF / NW35CF Conflat®	IGM 401 Y F D	IGM 401 T F D	IG4YF	IG4TF

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Conflat® is a registered trade mark of Varian Vacuum Technologies.

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InstruTech, Inc.

IGM-402 Hornet
Miniature-Ionization Vacuum Gauge Module with Dual Convection

Ion gauge with space-saving built-in controller and display operates 3 different gauges.

Full chamber control from 1 X 10-9 Torr to atmosphere plus monitoring of your foreline.

Low cost of ownership: Significant cost reduction in controller, space, cabling costs and sensor replacement.

Built-in bright yellow digital OLED display for wide viewing angle, RS-485 digital interface, 3 set-point relays and 3 log-linear analog outputs.

Rugged and compact metal construction Ionization Gauge with dual hot filament design.

The first modular Ionization vacuum gauge capable of operating two Convection gauges.

IGM-402 Ionization Gauge with Dual Convection

InstruTech IGM-402 "Hornet" Modules

Technology

Gauge: The IGM-402 Miniature-Ionization vacuum gauge module provides the basic signal conditioning required to turn the gauge into a complete measuring instrument. It incorporates numerous design features to enhance performance and reduce cost. The electrometer auto zeroes to ensure that readings are not subject to temperature drift. This eliminates the need for unnecessary and expensive circuitry which further reduces the cost.

Multiple Gauges : The IGM-402 is capable of operating two external Convection vacuum gauges simultaneously.

Full Range Measurement: The IGM-402 can combine the vacuum measurement from the Ion gauge and a Convection gauge to provide full range measurements from 1 x 10^{-9} Torr to atmosphere, or simply operate the Ion gauge and the two Convection gauges as individual gauges.

Display: The standard built-in bright yellow OLED display provides a convenient user interface for setup and operation of the vacuum gauges. The display screen can show all three measurements on the same screen or display them sequentially. Service screens can diagnose filament problems and monitor the filament life. Warnings will be displayed for all fault conditions.

Operation: The operation of the gauge including Degas, filament on/off and emission current is set by using digital inputs, via RS485 or the front panel push buttons.

Sensor: Dual Yttria Coated Iridium filaments are offered for general vacuum applications. The optional dual Tungsten filaments are available for use in applications not compatible with Yttria filaments such as those gases containing chlorine, fluorine, etc.

Low Cost of Ownership

Controller: The compact modular design with the built-in Controller and display operates three different gauges without requiring expensive external Controllers.

Space: No rack space required. The Modular design negates the need for expensive and limited rack space.

Cabling Cost: The cabling cost to connect a nude/glass Ionization gauge to a rack-mount Controller can be excessive and installation is time consuming. With the IGM-402 no Ion gauge cable is required and one 10-ft Convection gauge cable is included.

Sensor Replacement: Full range combination gauges provide full measurement range from atmosphere to high vacuum with multiple sensors built into one assembly. A sensor failure may require replacement of the entire sensor assembly often approaching 50% of the initial cost of the vacuum gauge itself.

The IGM-402 provides an alternative to these gauges by combining the vacuum measurements from the Ion gauge and one of the Convection gauges to provide a full range measurement gauge. A sensor replacement requires only the replacement of the damaged sensor and not all the other sensors at once.

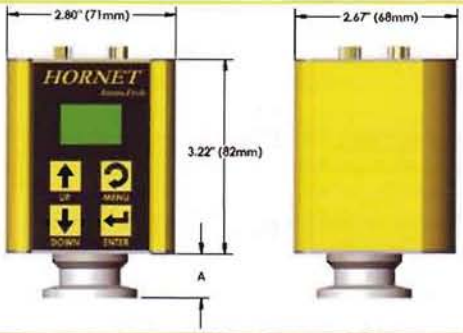
The IGM-402 Ion gauge sensor assembly can be easily replaced in the field by simply removing four socket head cap screws.

Additional Point of Use: In addition to one Ion gauge and one Convection gauge, the IGM-402 can provide vacuum measurements from a second Convection gauge without the need for another expensive Controller. This results in significant cost savings for monitoring the foreline or an additional point of use.

Specifications

measurement range: Ionization	1 x 10^{-9} to 5 x 10^{-2} Torr / 1.3 x 10^{-9} to 6.7 x 10^{-2} mbar / 1.3 x 10^{-7} to 6.7 Pa
Convection	1x 10^{-4} to 1000 Torr / 1x10^{-4} to 1333 mbar / 1x10^{-2} Pa to 133 kPa
used as a full range measurement gauge	1 x 10^{-9} to 1000 Torr / 1.3 x 10^{-9} to 1333 mbar / 1.3 x 10^{-7} Pa to 133 kPa
display	OLED graphical display, 3 digits plus 2 digits exponent, bright yellow
functionality	Ionization gauge can operate up to 2 Convection gauges
materials exposed to gases	Dual Filaments: Yttria Coated Iridium or optional Tungsten Ion Collector: Tungsten Grid: Tantalum Others: 316/304 SS, Glass, Nickel
sensitivity	Factory pre-set. Also user adjustable between 2 to 99.
X ray limit	< 5 x10^{-10}
emission current	100 uA, 4 mA
degas	4 Watts e-beam
overpressure protection	Gauge turns off at factory default setting of 5 X 10^{-2} Torr
internal gauge volume	1.0 in^3 (16.4 cm^3)
operating temperature	0 to + 40° C
bakeout temperature	200° C (sensor only - electronics removed)
humidity	0 to 95% RH non-condensing
weight	0.6 Lbs (0.27 kg) with NW25 KF flange
mounting orientation	Any
digital interface	RS485
analog outputs (3 total) Ionization gauge	One log-linear 0 to 9 Vdc, 1 V/decade **or** one log-linear 0.5 to 7 Vdc, 0.5 V/decade when used as a full range gauge with one Convection gauge
Convection vacuum gauges 1 & 2	Two log-linear 1-8 Vdc, 1 V/decade or non-linear 0.375 to 5.659 Vdc
setpoint relays (3 total)	Three single-pole, double-throw (SPDT), 1A at 30 Vdc resistive, 0.3 A at 125 Vac non-inductive. Adjust setpoints using front panel push buttons or RS-485
status outputs	Degas & filament on/off status are determined by an open collector transistor or via RS485 digital communications protocol
input signal/controls	Degas and filament on/off & emission current are set by continuity to ground using digital inputs, via RS485 or manually via front panel push buttons
filament selection	User selectable between filament 1 or 2 using the front panel push buttons or via RS485 commands
input Power	20 to 28 Vdc, 16 W
I/O Connector	(2) 9-pin D-Sub, (2) terminal blocks, (2) Convection gauge connectors
Convection gauge compatibility	InstruTech Worker Bee CVG101 or Granville Phillips 275 Convectron®
Convection gauge specifications	Refer to InstruTech Worker Bee CVG101 data sheet
RF/EMI protection	CE compliant

Fitting	dimension A
NW16KF	1.45" (37mm)
NW25KF	1.45" (37mm)
NW40KF	1.45" (37mm)
1-1/3" Mini CF	1.85" (47 mm)
2-3/4" Conflat®	1.70" (43 mm)



Ordering Information — Part Numbers

IGM-402 Module With Fitting:	W. Yttria Filaments	W. Tungsten Filaments	Convection Gauge Cable Assembly	Replacement Ion Sensors Yttria	Tungsten
NW16KF	IGM402YBD	IGM402TBD	HB431-1-3F (3-FT)	IG4YB	IG4TB
NW25KF	IGM402YCD	IGM402TCD	HB431-1-10F (10-FT)	IG4YC	IG4TC
NW40KF	IGM402YDD	IGM402TDD	HB431-1-25F (25-FT)	IG4YD	IG4TD
1-1/3" / NW 16CF Mini- Conflat®	IGM402YED	IGM402TED	HB431-1-50F (50-FT)	IG4YE	IG4TE
2-3/4" CF / NW35CF Conflat®	IGM402YFD	IGM402TFD	> 50 ft – Consult Factory	IG4YF	IG4TF

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InstruTech, Inc.

B-RAX 3000/3100 Ionization and Convection Vacuum Gauge Controller

- **Significant cost saving using a different approach to traditional full range vacuum measurements.**
- **Operates one InstruTech Ionization gauge (IG) plus two Convection gauges (CG).**
- **Alternate analog input from other types of vacuum gauges such as a Capacitance Diaphragm "CDG".**
- **Low heat generating, compact space saving half rack design, bench top or panel instrument.**
- **3 independent LED pressure measurement display channels plus 3 set-point relays for process control.**

Description

The complete system consists of :
One B-RAX Vacuum Gauge Controller
One InstruTech Hornet IGM-400 Ionization gauge module
Up to two CVG-101 Convection vacuum gauge tubes

The Electrometer for the Ionization gauge is built in to the InstruTech's IGM-400 Ionization gauge module instead of the Controller itself. This allows the B-RAX to be offered as a compact, low heat generating and low cost Controller.

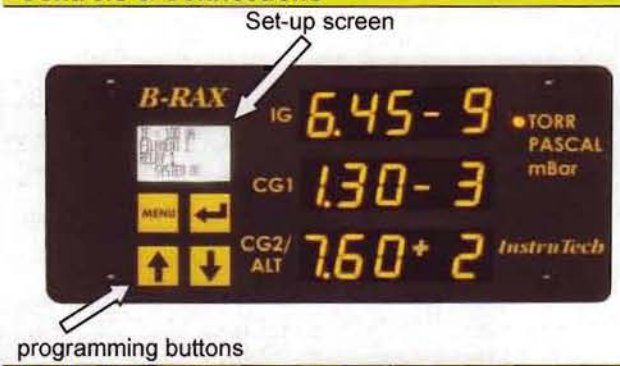
The B-RAX is offered as a space saving half rack design, bench top or instrument panel. It can be also be mounted as a full rack or dual rack using rack mount adapters.

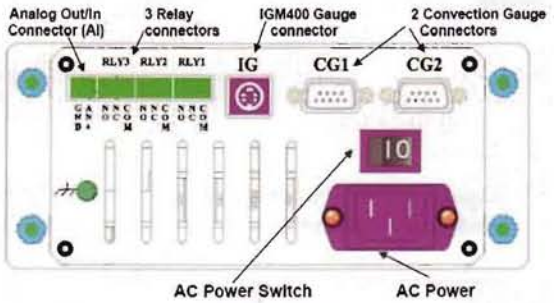
B-RAX Multi-Gauge Vacuum Measurement System

Specifications

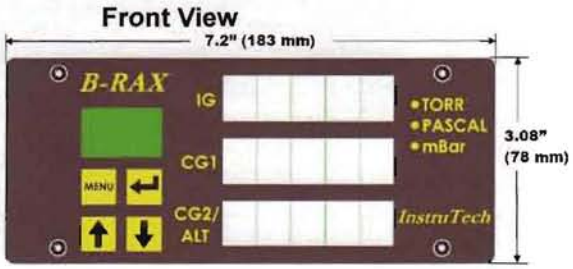
measurement range:		1 x 10^{-9} to 1000 Torr / 1.3 x 10^{-9} to 1333 mbar / 1.3 x 10^{-7} Pa to 133 kPa
display	Pressure	3 Independent display channels - 3 digits plus 2 digits exponent LED per channel Displays one Ion gauge, two Convection gauges or optional alternate gauge
	setup and programming	Front panel LCD setup screen with push buttons
	Engineering Units	Torr, mBar, Pascals (user selectable)
Functionality	Ionization Gauge	Operates one InstruTech IGM-400 Ionization Vacuum Gauge Module
	Convection Gauge	Operates up to two Worker Bee CVG-101 or Granville-Phillips Convectron® Convection vacuum gauge tubes
Alternate Gauge(BRAX 3000 only)		1 alternate 0-10 Vdc analog input from other gauges such as a Capacitance Diaphragm
IG filament control		User selectable between filament 1 or 2 using front panel push buttons
IG emission current		100 uA, 4 mA, or automatic switching between 100 uA and 4 mA
IG degas		4 Watts e-beam
IG overpressure protection		Turns off Ion gauge at a factory default setting of 5 X 10^{-2} Torr Can also be set up for filament auto turn on/off using a Convection gauge
IG status		Emission current, Relay, Filament and Degas on/off status displayed on set up screen
operating temperature		0 to + 50° C
storage temperature		-40 to + 70° C
humidity		0 to 95% RH non-condensing
weight		3.6 Lbs (1.62 kg)
Analog Output (BRAX 3100 only)		One analog output can be assigned to the Ion gauge "IG", or one Convection gauge "CG" or IG + CG for full range measurements IG only = Log linear 0 -9V, 1V/decade, IG + CG = Log linear 0.5 V to 7V, 0.5 V/decade CG1 or CG2 = Log linear 0-7 V or 1-8 V, 1V decade
setpoint relays		3 user programmable single-pole, double-throw (SPDT), 1A at 30 Vdc resistive, or ac non-inductive. Multiple relays assignable to one gauge or one relay per gauge.
Input Power		100-240 Vac, 50/60Hz, universal power
RF/EMI protection		CE compliant

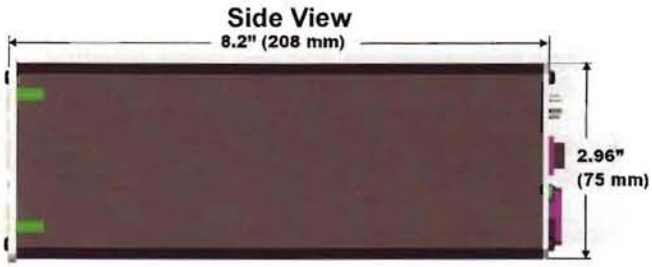
Controls & Connections

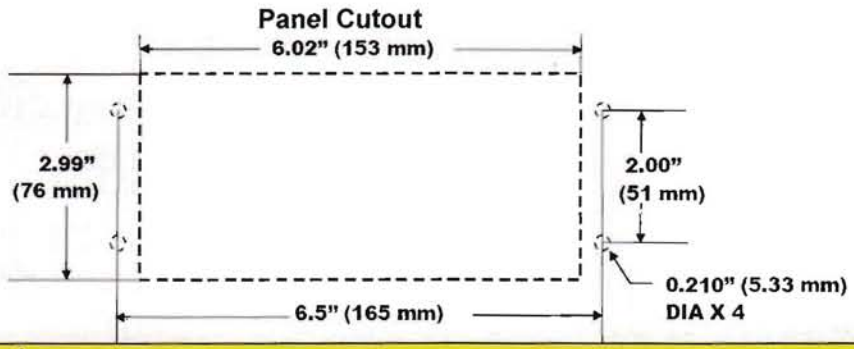




Outline Drawing







Ordering Information — Part Numbers

B-RAX 3000 (3 display channels, 3 set-point relays, no analog output, one alternate analog input from a CDG) B-RAX 3100 (3 display channels, 3 set-point relays, one analog output, no alternate analog input from a CDG) *(includes mating interface connectors, power cord & plug.)*	B-RAX 3000 B-RAX 3100

IGM-400 Ionization Gauge	See IGM-400 Hornet Ionization gauge data sheet
CVG-101 Convection Gauge	See CVG-101 Worker Bee Convection gauge data sheet

Cables	IGM 400 Ionization gauge cable	CVG101 Convection gauge cable
10 FT (3 m)	BXC400-1-10F	CB421-1-10F
25 FT (8m)	BXC400-1-25F	CB421-1-25F
50 FT (15m)	BXC400-1-50F	CB421-1-50F
> 50 FT	Consult factory	Consult factory

Optional Rack Mount Adapter	
Rack Mount adapter panel for installation of one B-RAX in center of a 19 inch rack	000849
Rack Mount adapter panel for installation of two B-RAX side-by-side in a 19 inch rack	001007

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InstruTech, Inc.

IGM-400 Hornet
Miniature-Ionization Vacuum Gauge Module

Wide measurement range
1×10^{-9} to 5×10^{-2} Torr
1.3×10^{-9} to 6.7×10^{-2} mbar
1.3×10^{-7} to 6.7 Pa

Full range measurement from 1×10^{-9} Torr to atmosphere when used with the B-RAX Controller and a Convection Gauge.

Designed specifically for use with InstruTech's B-RAX vacuum gauge Controller.

Dual Hot Filament design, rugged and compact metal construction

Significant cost savings compared to other vacuum gauge measurement systems.

Built-in Electrometer results in significant Controller and cabling cost reduction.

Description

The IGM-400 is the Ionization gauge module component of InstruTech's B-RAX multi-gauge vacuum measurement system. All display and control functions are done remotely using the B-RAX.

The complete system consists of :
One B-RAX vacuum gauge Controller
One InstruTech Hornet IGM-400 Ionization gauge
Up to two CVG-101 Convection vacuum gauge tubes

The measurements from the IGM-400 are displayed on the IG display screen of the B-RAX Controller (see B-RAX data sheet for Controller specifications).

IGM-400 used with B-RAX Vacuum Measurement System

InstruTech IGM-400 Ionization Gauge

The IGM-400 Miniature-Ionization vacuum gauge module provides the basic signal conditioning required to turn the gauge into a complete measuring instrument.

The IGM-400 is functional only when used with the B-RAX Vacuum gauge Controller. This allows the user to remotely operate the IGM-400 from the B-RAX Controller.

InstruTech has made numerous design enhancements to the IGM-400 to reduce cost and improve performance. The electrometer auto zeroes to ensure that the readings are not subject to temperature drift. This eliminates the need for unnecessary and expensive circuitry which further reduces the cost.

All operations including Filament on/off, Degas, and change of emission current is controlled from the B-RAX.

The emission current can be set to automatically switch between 4 ma and 100 uA. This results in optimal and stable pressure readings over the entire measurement range from low to high vacuum.

The IGM-401 gauge tube assembly is constructed of a compact all metal design with dual Yttria coated Iridium or optional dual Tungsten filaments.

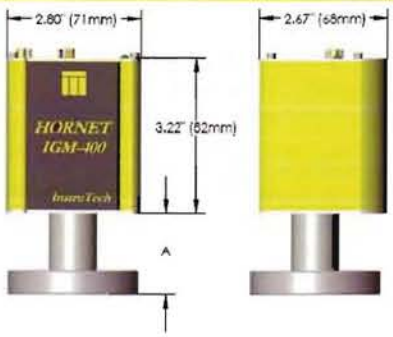
The gauge sensor assembly can be easily replaced in the field by simply removing four socket head cap screws.

Dual Yttria Coated filaments are offered for general vacuum applications. The optional dual Tungsten filaments are available for use in applications not compatible with Yttria filaments such as those gases containing chlorine, fluorine, etc.

Specifications

measurement range	1 x 10^{-9} to 5 x 10^{-2} Torr / 1.3 x 10^{-9} to 6.7 x 10^{-2} mbar / 1.3 x 10^{-7} to 6.7 Pa
materials exposed to gases	Dual Filaments: Yttria Coated Iridium or optional Tungsten Ion Collector: Tungsten Grid: Tantalum Others: 316/304 SS, Glass, Nickel
sensitivity	Factory pre-set. Also user adjustable from 2 to 99 (set by B-RAX Controller)
X ray limit	< 5 x10^{-10}
emission current	100 uA, 4 mA, or automatic switching between 100 uA and 4 mA
degas	4 Watts e-beam
overpressure protection	Gauge is auto turned off by at factory default setting of 5 X 10^{-2} Torr B-RAX can also be set up to auto filament turn on/off using a Convection gauge
filament status	Filament on/off status LED located on the IGM-400. The filament on/off status also displayed by the B-RAX controller.
internal gauge volume	1.0 in^3 (16.4 cm^3)
operating temperature	0 to + 40° C
bakeout temperature	200° C (sensor only - electronics removed)
humidity	0 to 95% RH non-condensing
weight	0.6 Lbs (0.27 kg) with NW25 KF flange
mounting orientation	Any
Interface	Functional only when used with the B-RAX Controller
setpoint relay	Relays available from the B-RAX. (See B-RAX data sheet)
input signal	All IGM-400 operations controlled from B-RAX
filament selection	User selectable between filament 1 or 2 - command signal sent from B-RAX
input power	Powered by B-RAX Controller
RF/EMI protection	CE compliant
Connector/cabling	InstruTech custom cable/connector assembly for connection to B-RAX

Fitting	dimension A
NW16KF	1.45" (37mm)
NW25KF	1.45" (37mm)
NW40KF	1.45" (37mm)
1-1/3" Mini CF	1.85" (47 mm)
2-3/4" Conflat®	1.70" (43 mm)



Ordering Information Part Numbers

InstruTech IGM-400 Module With Fitting:	With Yttria Filaments	With Tungsten Filaments	Replacement Sensor - Yttria	Replacement Sensor - Tungsten
NW16KF	IGM 400 Y B X	IGM 400 T B X	IG4YB	IG4TB
NW25KF	IGM 400 Y C X	IGM 400 T C X	IG4YC	IG4TC
NW40KF	IGM 400 Y D X	IGM 400 T D X	IG4YD	IG4TD
1-1/3"Mini-CF/NW16CF Mini-Conflat®	IGM 400 Y E X	IGM 400 T E X	IG4YE	IG4TE
2-3/4" CF / NW35CF Conflat®	IGM 400 Y F X	IGM 400 T F X	IG4YF	IG4TF

B-RAX Controller	See B-RAX Controller data sheet
IGM cabling/connector	See B-RAX Controller data sheet
CVG-101 Convection gauge	See CVG-101 Worker Bee Convection gauge data sheet
CVG cabling/connector	See B-RAX Controller data sheet

Conflat® is a registered trade mark of Varian Vacuum Technologies.

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InstruTech, Inc.

CVM-211 "Stinger" Convection Vacuum Gauge Module Measurement Unit & Display – Torr/mTorr

- **Wide measurement range 10^{-4} to 1000 Torr** — ***Monitor your vacuum system from atmosphere to 10^{-4} Torr with a single gauge.***
- **Built-in digital display with analog output and setpoint relay.** — ***Easy setup and operation.***
- **Wider measuring range and better accuracy than TC gauges.** — ***Upgrade your vacuum system and process performance.***
- **Also a low cost, plug-compatible direct drop-in replacement for the most basic Granville-Phillips Mini-Convectron® models.** — ***Significant cost savings Simplest and lowest cost vacuum gauge solution for many vacuum systems.***

The InstruTech CVM-211 Sensor

The sensor inside the CVM-211 "*Stinger*" module incorporates numerous design enhancements compared to other traditional Convection vacuum gauges.

Temperature compensation has been moved out of the vacuum environment and placed around the outside of the vacuum gauge tube. This has eliminated a dozen or so unnecessary parts and welds, significantly increasing the reliability, providing optimal vacuum measurement while reducing cost. The improved mechanical strength results in a highly robust vacuum gauge less susceptible to mechanical shock and vibration. Other design features include reduced internal volume and significant reduction of internal surface area resulting in faster pump-down and less outgassing. A fine mesh screen in the gauge inlet port helps prevent particulate contamination from entering the gauge. The gauge is shielded against RF interference. Guided by our vast experience and vacuum measurement know how, our sensors are specifically designed for reliability and manufacturability.

These, and other, design features add up to a highly reliable vacuum gauge with significant cost savings that are passed on to you.

The InstruTech CVM-211 Built-in Controller

InstruTech's CVM-211 "*Stinger*" module provides the necessary signal conditioning to turn the Convection gauge into a complete vacuum measuring instrument.

The CVM-211 module provides one log-linear or non-linear analog output and one setpoint relay. In addition, a built-in display provides the measured pressure values and provides for a convenient user interface for setup and operation of the vacuum gauge.

Low-cost upgrade for thermocouple TC vacuum gauges

The *Stinger* provides a wider measuring range than traditional thermocouple vacuum gauges - from 10^{-4} Torr to atmosphere - so you can monitor your entire pump-down and vent cycle.

The CVM-211 Convection Enhanced Pirani gauge is more accurate than a thermocouple gauge, especially at lower pressures. And depending on your gauge/readout configuration, the cost of a *Stinger* is about the same, or very little more, than the cost of a TC gauge system.

Also a direct drop-in replacement for GP Mini-Convectron® modules

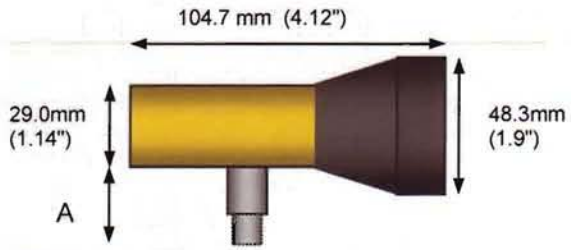
The *Stinger* can also directly replace the most basic Granville-Phillips Mini-Convectron® modules, at significantly lower cost. The InstruTech *Stinger* provides equivalent or better performance throughout the range of 10^{-4} to 1000 Torr.

The 9-pin D connector has the same pinouts and signals as the corresponding Mini-Convectrons®. The non-linear analog signal and setpoint relay are identical to their corresponding Mini-Convectron® functions. With *Stinger*'s performance, more robust design, longevity, smaller size, and lower cost, your process could only improve.

Whether you're looking to reduce costs or improve your process, the CVM-211 Stinger offers a cost-effective solution for your vacuum gauging needs.

Specifications

measurement range (signal)	$1x10^{-4}$ to 1000 Torr / $1x10^{-4}$ to 1333 mbar / $1x10^{-2}$ Pa to 133 kPa
display	3 digit LED (3 digits from 999 Torr to 10.0 mTorr), (2 digit LED from 9.9 mTorr to 1.0 mTorr), (1 digit LED from 0.9 mTorr to 0.1 mTorr)
materials exposed to gases	gold-plated tungsten, 304 & 316 stainless steel, glass, nickel, Teflon
internal volume	26 cm^3 (1.589 in^3)
internal surface area	59.7 cm^2 (9.25 in^2)
weight	136 g (4.8 oz)
housing	molded plastic
fittings/flanges	1/8"NPT-1/2" tubulation, 4VCR, 8VCR, Mini-Conflat® (NW16CF), 2-3/4" Conflat® (NW35CF), KF16, KF25, KF40
operating temperature	0 to +40 °C
storage temperature	-40 to +70 °C
bakeout temperature	+70 °C
humidity	0 to 95% RH non-condensing
mounting position	horizontal recommended
analog output	1) log-linear 1 to 8 Vdc , 1V/decade, or 2) non-linear analog S-curve 0.375 to 5.659 Vdc
input power	11 to 30 Vdc, protected against power reversal, transients, and over-voltages
trippoint relay	one, single-pole double-throw relay (SPDT)
contact rating	1A at 30 Vdc resistive, or ac non-inductive
connector	9-pin D male
RF/EMI protection	CE compliant



fitting	dimension A
1/8"NPT - ½" tube	25.4mm (1.00")
NW16KF	33.0mm (1.30")
NW25KF	33.0mm (1.30")
NW40KF	33.0mm (1.30")
1-1/3" Mini-Conflat®	37.3mm (1.47")
2-3/4" Conflat®	37.3mm (1.47")
¼" Cajon® 4VCR	47.2mm (1.86")
½" Cajon® 8VCR	44.5mm (1.75")

Ordering Information

InstruTech CVM-211 Module Fitting type:	With Log-Linear Analog Output	With Non-Linear Analog Output
1/8"NPT - ½" tube	CVM211GAL	CVM 211 G AA
NW16KF	CVM211GBL	CVM 211 G B A
NW25KF	CVM211GCL	CVM 211 G C A
NW40KF	CVM211GDL	CVM 211 G D A
1-1/3" Mini-CF / NW16CF Mini-Conflat®	CVM211GEL	CVM 211 G E A
2-3/4" CF / NW35CF Conflat®	CVM211GFL	CVM 211 G F A
¼" Cajon® 4VCR female	CVM211GGL	CVM 211 G G A
½" Cajon® 8VCR female	CVM211GHL	CVM 211 G H A

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Cajon® is a registered trade mark of the Swagelok Company.
Conflat® is a registered trade mark of Varian Vacuum Technologies

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InstruTech, Inc.

CVM-201 Super Bee
Convection Vacuum Gauge Module

Wide measurement range:
10^{-4} to 1000 Torr
10^{-4} to 1333 mbar
10^{-2} Pa to 133 kPa

Monitor your vacuum system from atmosphere to 10^{-4} Torr with a single gauge.

Low cost, direct drop-in plug-compatible replacement for the GP Mini-Convectron® module

Significant savings for you. Use your existing hardware, cables, and software. No changes to your process.

Built-in digital display, two setpoints, non-linear, linear, log-linear analog outputs, and RS232/485 interface are all included in standard module

You can stock just one Super Bee module to support all your equipment - one InstruTech module replaces most Mini-Convectron® configurations.

InstruTech CVG Gauges

The Convectron® gauge has been in widespread use worldwide, largely unchanged since Granville-Phillips introduced it in 1975. InstruTech has completely redesigned its new gauge for significantly lower cost, without sacrificing high quality and performance. The InstruTech convection gauge provides equivalent or better performance throughout the range of 10^{-4} to 1000 Torr.

InstruTech CVM-201 "Super Bee" Modules

The InstruTech CVM-201 module provides the basic signal conditioning required to turn the gauge into a complete measuring instrument. The CVM-201 "Super Bee" module provides non-linear and linear or log-linear analog outputs, RS232/485 interface, and two setpoint relays. A built-in display provides a convenient user interface for setup and operation of the vacuum gauge.

Direct drop-in plug-compatible replacement for the GP Mini-Convectron®

The InstruTech CVM-201 module will directly replace most Granville-Phillips Mini-Convectron® modules. Linear and non-linear analog signals, digital interfaces, and setpoint relays are all included on the standard InstruTech module. All are identical to their corresponding Mini-Convectron® functions. Software commands are the same.

GP Mini-Convectron® modules use *either* a 9-pin D-sub *or* 15-pin high-density D-sub connector, with 6 different pinout configurations, depending on model and options. If you have more than one vacuum system, you probably have several different Mini-Convectron® models to support. The CVM-201 uses *both* a 9-pin D-sub *and* a 15-pin high density D-sub connector to bring out all these functions in the same pinout configurations.

One InstruTech CVM-201 module can directly replace dozens of different Mini-Convectron® configurations, reducing the number of spares you need to keep on hand.

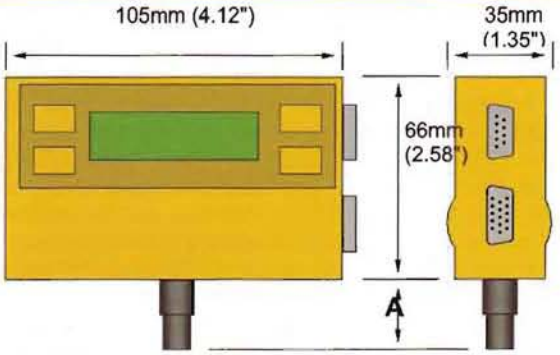
Lower cost without sacrificing quality or functionality.

InstruTech has made numerous changes to reduce cost and improve performance. Temperature compensation has been moved out of the vacuum environment, significantly reducing costs and improving performance. The gauge is bakeable to 150°C (electronics removed) and shielded against RF interference. A fine mesh screen in the gauge port helps prevent particulate contamination from entering the gauge. The sensor is far more reproducible and easier to make. These, and other, improvements add up to significant cost savings to you.

Similar improvements have been incorporated into the module electronics. The biggest cost savings comes from manufacturing a single model, with all possible options, instead of making dozens of different pc boards and models. And you don't have to give up one feature to get another you want: You *can* have an analog output with an RS485 interface, or a linear output with setpoints, or an RS485 interface with a display. The standard InstruTech module includes all these features at a cost comparable to the most basic model Mini-Convectron®.

Specifications

measurement range (signal)	$1x10^{-4}$ to 1000 Torr / $1x10^{-4}$ to 1333 mbar / $1x10^{-2}$ Pa to 133 kPa
display	LCD, 4 digits, user-selectable Torr, mbar, or Pa 1000Torr, (4 digits from 1100 Torr to 1000 Torr), (3 digits from 999 Torr to 10.0 mTorr), (2 digits from 9.9 mTorr to 1.0 mTorr), (1 digit from 0.9 mTorr to 0.1 mTorr)
materials exposed to gases	gold-plated tungsten, 304 & 316 stainless steel, glass, nickel, Teflon
internal volume	26 cm^3 (1.589 in^3)
internal surface area	59.7 cm^2 (9.25 in^2)
weight	340 gm (12 oz)
housing	aluminum extrusion 105 x 66 x 35mm (4.12 x 2.58 x 1.35 inches)
fittings/flanges	1/8"NPT-1/2" tubulation, 4VCR, 8VCR, Mini-Conflat® (NW16CF), 2-3/4" Conflat®(NW35CF), KF16, KF25, KF40
operating temperature	0 to +40 °C
storage temperature	-40 to +70 °C
bakeout temperature	150 °C (gauge only - electronics removed)
humidity	0 to 95% RH non-condensing
mounting position	horizontal recommended
analog outputs	1) non-linear S-curve 0.375 to 5.659 Vdc 2a) linear 0 to 10 Vdc, user scalable (default is 0-10Vdc = 0-1 Torr), or 2b) log-linear 1 to 8 Vdc, 1V/decade
digital interface	RS485 / RS232
input power	11 to 30 Vdc, protected against power reversal, transients, and over-voltages
trippoint relays	two, single-pole double-throw relays (SPDT)
contact rating	1A at 30 Vdc resistive, or ac non-inductive
connectors	9-pin D male and 15-pin high-density D male
RF/EMI protection	CE compliant



fitting	dimension A
1/8"NPT - ½" tube	21.8mm (0.86")
NW16KF	29.5mm (1.16")
NW25KF	29.5mm (1.16")
NW40KF	29.5mm (1.16")
1.33" Mini-Conflat CF16	34.0mm (1.34")
2.75" Conflat CF35	34.0mm (1.34")
1/4" Cajon 4VCR	43.7mm (1.72")
1/2" Cajon 8VCR	40.9mm (1.61")

Ordering Information

InstruTech CVM-201 Module, with fitting:	CVM-201 Part Number
1/8"NPT - ½" tube	CVM 201 G A A
NW16KF	CVM 201 G B A
NW25KF	CVM 201 G C A
NW40KF	CVM 201 G D A
1-1/3" Mini-CF / NW16CF Mini-Conflat®	CVM 201 G E A
2-3/4" CF / NW35CF Conflat®	CVM 201 G F A
¼" Cajon® 4VCR female	CVM 201 G G A
½" Cajon® 8VCR female	CVM 201 G H A

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Cajon® is a registered trade mark of the Swagelok Company.
Conflat® is a registered trade mark of Varian Vacuum Technologies.

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InstruTech, Inc.

VGC-301 Convection Vacuum Gauge Controller

- **Wide measuring range lets you monitor your vacuum system from 1000 to 10^{-4} Torr with a single gauge.**
- **Includes two setpoints, user-selectable analog output, and RS232/485 interfaces.**
- **Analog output is configurable as a non-linear S-curve, log-linear, or user-scalable linear.**
- **Space-saving 1/8-DIN panel mount housing.**
- **Powered by universal 100-240 VAC or 12-30 VDC.**

Description

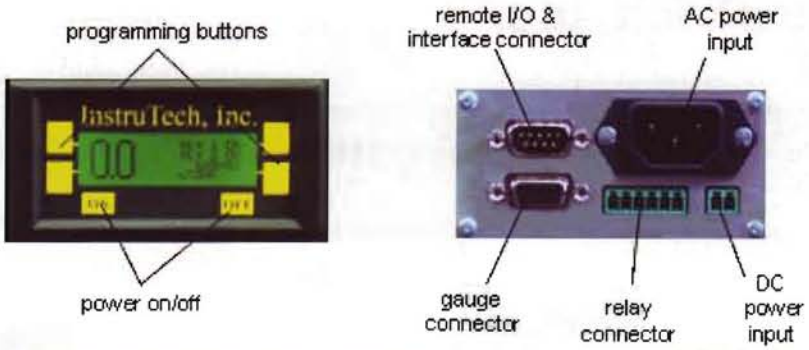
The VGC-301 vacuum gauge controller is a convenient and inexpensive power supply and readout instrument for a CVG "*Worker Bee*" convection vacuum gauge. The 1/8-DIN housing can be used on the bench top or mounted in a cutout in an instrument panel. The VGC-301 is powered by 12-30 VDC, or by its self-contained universal 100-240VAC supply.

Compatibility: Signals and relay functions are the same as found on similar Convection gauge controllers from other manufacturers. The VGC-301, CVG gauge, and gauge cable can be directly interchanged with Granville-Phillips 375 Controller, 275 Convectron® gauge, and gauge cable. (Remote interface, relay, and power connectors are different.)

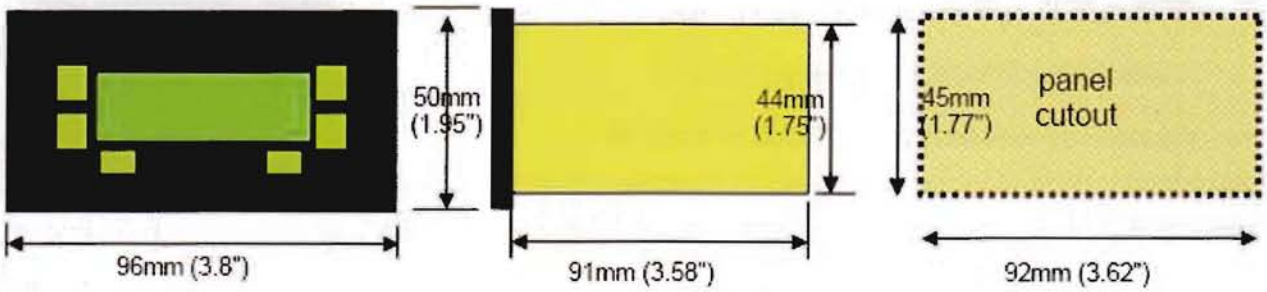
Specifications

measurement range	$1x10^{-4}$ to 1000 Torr $1x10^{-4}$ to 1333 mbar $1x10^{-2}$ Pa to 133 kPa
resolution	$1x10^{-4}$ Torr / $1x10^{-4}$ mbar / $1x10^{-2}$ Pa
display	Four-digit LCD, displays 4 digits from 1100 Torr to 1000 Torr 3 digits from 999 Torr to 10.0 mTorr 2 digits from 9.9 mTorr to 1.0 mTorr 1 digit from 0.9 mTorr to 0.1 mTorr
display engineering units	Torr, mbar, or Pa - user selectable
display update rate	0.5 sec
weight	250 gm (9 oz)
operating temperature	0 to +40 °C ambient
storage temperature	-40 to +70 °C
humidity	0 to 95% RH non-condensing
analog output (user-selectable)	a) non-linear S-curve 0.375 to 5.659 Vdc, or b) linear 0 to 10 Vdc, user scalable (default is 10Vdc = 1 Torr), or c) log-linear 1 to 8 Vdc, 1V/decade
digital interface	RS232 and RS485
housing	1/8-DIN panel-mount enclosure (see outline drawing for dimensions)
input power	100-240 Vac, 50/60Hz, universal power supply or 12-30 Vdc
setpoint relays	two single-pole double-throw relays (SPDT)
contact rating	1A at 30 Vdc resistive, or ac non-inductive
trippoint range	$1x10^{-3}$ to 1000 Torr
adjustment	a) adjust value by panel pushbutton up/down keys and display b) adjust value, direction, and hysteresis by software/interface
connectors	gauge: 9-pin D female analog output and digital interface: 9-pin D male relay outputs: 6-pin pluggable terminal block power: universal AC and 2-pin pluggable terminal block DC
RF/EMI protection	CE compliant

Controls & Connections



Outline Drawing



Ordering Information

VGC 301 A Convection Vacuum Gauge Controller	VGC 301 A
(Includes mating interface connectors, and North American 115VAC power cord & plug. Contact us for availability of power cords and plugs for other countries.)	
InstruTech CVG Gauge:	
1/8"NPT - ½" tube	CVG 101 G A
NW16KF	CVG 101 G B
NW25KF	CVG 101 G C
NW40KF	CVG 101 G D
1-1/3" Mini-CF / NW16CF Mini-Conflat®	CVG 101 G E
2-3/4" CF / NW35CF Conflat®	CVG 101 G F
¼" Cajon® 4VCR female	CVG 101 G G
½" Cajon® 8VCR female	CVG 101 G H
Gauge Cables:	
10 ft (3m)	CB 421-1- 10F
25 ft (8m)	CB 421-1- 25F
50 ft (15m)	CB 421-1- 50F
over 50 ft (15m) custom lengths available up to 100 ft (30 m)	CB 421-1 - xxxF or - yyM

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InstruTech, Inc.

CVG-101 Worker Bee Convection Vacuum Gauge

Wide measuring range
10^{-4} to 1000 Torr
10^{-4} to 1333 mbar
10^{-2} Pa to 133 kPa

A single vacuum gauge can monitor your vacuum system pump-down and venting.

Wider measuring range and better accuracy than thermocouple gauges.

Upgrade your vacuum system and process performance.

Also a low cost, plug-compatible, direct drop-in replacement gauge for GP Convectron® and Mini-Convectron® gauges.

Significant savings for you. No changes to your system. Use your existing Convectron® controllers, cables, and modules.

The InstruTech CVG-101 Sensor

The CVG-101 "Worker Bee" Convection vacuum gauge sensor incorporates numerous design enhancements compared to other traditional Convection vacuum gauges.

Temperature compensation has been moved out of the vacuum environment and placed around the outside of the vacuum gauge tube. This has eliminated a dozen or so unnecessary parts and welds, significantly increasing the reliability, providing optimal vacuum measurement while reducing cost. The improved mechanical strength results in a highly robust vacuum gauge less susceptible to mechanical shock and vibration.

Other design features include reduced internal volume and significant reduction of internal surface area resulting in faster pump-down and less outgassing. A fine mesh screen in the gauge inlet port helps prevent particulate contamination from entering the gauge. The gauge is shielded against RF interference. Guided by our vast experience and vacuum measurement know how, our sensors are specifically designed for reliability and manufacturability.

These, and other, design features add up to a highly reliable vacuum gauge with significant cost savings that are passed on to you.

Upgrade for thermocouple TC vacuum gauges

The *Worker Bee* provides wider measuring range than traditional thermocouple vacuum gauges - from 10^{-4} Torr to atmosphere - so you can monitor your entire pump-down and vent cycle.

The CVG-101 *Worker Bee* Convection Enhanced Pirani gauge is more accurate than a thermocouple gauge, especially at lower pressures.

Also a Low cost drop-in replacement for the GP Convectron® Gauge

The *Worker Bee* can also directly replace the Granville-Phillips Convectron® sensor, at significantly lower cost.

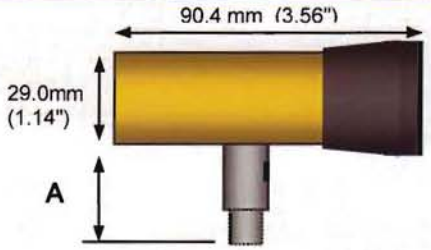
The InstruTech CVG convection vacuum gauge provides equivalent or better performance throughout the range of 10^{-4} to 1000 Torr (10^{-4} to 1333 mbar). Only the same, equivalent, or better materials are used in the vacuum environment. Clean assembly procedures assure compatibility with today's contamination-sensitive processes. All tooling that comes in contact with vacuum surfaces of the InstruTech gauge are of very low vapor pressure materials.

The sensor connector has the same pinouts and signal as the corresponding Convectron®. It is directly interchangeable with your existing Convectron® controllers, cables, so you don't need to change any wiring, hardware, or process recipes. With *Worker Bee's* performance, more robust design, longevity, and lower cost, your process could only improve

Whether you're looking to reduce costs or improve your process, the CVG-101 Worker Bee offers a cost-effective solution for your vacuum gauging needs

Specifications

measurement range	$1x10^{-4}$ to 1000 Torr $1x10^{-4}$ to 1333 mbar $1x10^{-2}$ Pa to 133 kPa
resolution	$1x10^{-4}$Torr, $1x10^{-4}$mbar, $1x10^{-2}$ Pa
temperature - operating	0 to 50 °C
temperature - bakeout	150 °C maximum, non-operating, with cable or electronics removed
humidity - operating	0 to 95% RH non-condensing
mounting orientation	horizontal recommended
materials exposed to vacuum	gold-plated tungsten, 304 & 316 stainless steel, glass, nickel, Teflon
internal volume	26 cm^3 (1.589 in^3)
internal surface area	59.7 cm^2 (9.25 in^2)
leak integrity	< $1x10^{-9}$ atm cc/sec He
weight	85 gm (3 oz)
RF/EMI protection	CE compliant



fitting	dimension A
1/8"NPT - ½" tube	25.4mm (1.00")
NW16KF	33.0mm (1.30")
NW25KF	33.0mm (1.30")
NW40KF	33.0mm (1.30")
1-1/3" Mini-Conflat®	27.4mm (1.08")
2-3/4" Conflat®	21.6mm (0.85")
¼" Cajon® 4VCR	47.2mm (1.86")
½" Cajon® 8VCR	44.5mm (1.75")

Ordering Information	InstruTech CVG	Convectron®
Standard Gauges		
1/8"NPT - ½" tube	CVG 101 G A	275071
NW16KF	CVG 101 G B	275203
NW25KF	CVG 101 G C	275196
NW40KF	CVG 101 G D	275316
1-1/3" Mini-CF / NW16CF Mini-Conflat®	CVG 101 G E	275256
2-3/4" CF / NW35CF Conflat®	CVG 101 G F	275238
¼" Cajon® 4VCR female	CVG 101 G G	275185
½" Cajon® 8VCR female	CVG 101 G H	275282
Gauges for Mini-Convectron® Modules		
1/8"NPT - ½" tube	CVG 102 G A	275810
NW16KF	CVG 102 G B	275816
NW25KF	CVG 102 G C	275817
NW40KF	CVG 102 G D	275818
1-1/3" Mini-CF / NW16CF Mini-Conflat®	CVG 102 G E	275813
2-3/4" CF / NW35CF Conflat®	CVG 102 G F	275814
¼" Cajon® 4VCR female	CVG 102 G G	275811
½" Cajon® 8VCR female	CVG 102 G H	275864

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PRICE LIST FOR INSTRUTECH VACUUM INSTRUMENTATION - IONIZATION GAUGES

IGM-402 "Hornet" module with Dual Convection. Includes Ion gauge sensor, built-in Controller with display, 3 set-point relays, 3 Log-linear analog outputs, RS-485 interface and one 10 foot (3m) cable assembly for connection to one Worker Bee Convection gauge tube. User programmable in Torr, mbar, or Pa. CVG101 Convection gauge tubes must be ordered separately. (See below)

Model No.	Description / Fitting		NW16	NW25	NW40	1.33 CF	2.75 CF		
IGM-402	Ion Gauge with 2 Convection	Yttria Coated Iridium Fils.	IGM402YBD $913	IGM402YCD $935	IGM402YDD $946	IGM402YED $935	IGM402YFD $946		
		Tungsten Filaments	IGM402TBD $913	IGM402TCD $935	IGM402TDD $946	IGM402TED $935	IGM402TFD $946		

Hornet to Worker Bee Gauge Cable (One 10 ft cable assembly included with IGM402).

	3ft (1m)	10ft (3m)	25ft (8m)	50ft (15m)	Over 50ft (15m) up to 100ft (30m). Specify length in xxF or yyM
P/N and Price	HB431-1-03F $53	HB431-1-10F $77	HB431-1-25F $94	HB431-1-50F $121	HB431-1-xxF or yyM $72 + $1.10/ft or $72 + $3.67/m. Example 100ft = $182

IGM-401 "Hornet" module. Includes Ion gauge sensor, built-in controller with display, one set-point relay, one Log-linear analog output and RS-485 interface. User programmable in Torr, mbar, or Pa.

Model No.	Description / Fitting		NW16	NW25	NW40	1.33 CF	2.75 CF	
IGM-401	Ion Gauge	Yttria Coated Iridium Fils.	IGM401YBD $858	IGM401YCD $880	IGM401YDD $891	IGM401YED $891	IGM401YFD $902	
IGM-401	Ion Gauge	Tungsten Filaments	IGM401TBD $858	IGM401TCD $880	IGM401TDD $891	IGM401TED $891	IGM401TFD $902	

Replacement "Hornet" gauge Sensor Assemblies

	Description / Fitting		NW16	NW25	NW40	1.33 CF	2.75 CF		
	Replacement Sensor	Yttria Coated Iridium Sensor.	IG4YB $237	IG4YC $259	IG4YD $270	IG4YE $270	IG4YF $281		
	Replacement Sensor	Tungsten Sensor	IG4TB $237	IG4TC $259	IG4TD $270	IG4TE $270	IG4TF $281		

AC Power Supply for IGM-402 and IGM-401 "Hornet" modules - universal 100-240 VAC input, North America 115VAC plug.	Part No. - PS501-A	Price $83.

"B-RAX" Multi-Gauge Vacuum Gauge Controller User programmable in Torr/mtorr, mbar or Pa Operates One IGM-400 Ion gauge and two CVG-101 Worker Bee Convection gauges. (Note: Ionization gauge module, Convection gauges, and interconnecting cables must be ordered separately (see items above and below).

Multi-Gauge Gauge Vacuum Gauge Controller 3 pressure display channels, 3 set-point relays, **no** analog output. powered by 100-240VAC. Includes power cord.	B-RAX3000	$660
Multi-Gauge Gauge Vacuum Gauge Controller 3 pressure display channels, 3 set-point relays, **one** analog output. powered by 100-240VAC. Includes power cord.	B-RAX3100	$660

Cables for use with B-BRA and Gauge Sensors	**Length**	**IGM-400 to B-BRAX P/N**	**CVG-101 to B-BRAX P/N**	**Price**
	10ft (3m)	**BCX400-1-10F**	**CB421-1-10F**	**$77**
	25ft (8m)	**BCX400-1-25F**	**CB421-1-25F**	**$94**
	50ft (15m)	**BCX400-1-50F**	**CB421-1-50F**	**$121**
	>50ft	**Request Quote**	**Request Quote**	**POR**

PRICE LIST FOR INSTRUTECH VACUUM INSTRUMENTATION - CONVECTION GAUGES

CVG-101 Worker Bee Convection Gauge

Model No.	Description / Fitting	⅛" NPT - ½ Tube	NW16	NW25	NW40	1.33 CF	2.75 CF	¼" Cajon® 4VCR	½" Cajon® 8VCR
CVG-101	Convection	CVG101GA $108	CVG101GB $130	CVG101GC $140	CVG101GD $152	CVG101GE $140	CVG101GF $152	CVG101GG $140	CVG101GH $152

Replacement Gauges for Brooks Automation /Granville Phillips Mini-Convectron® Modules

CVG201	Convection	CVG102GA $108	CVG102GB $130	CVG102GC $140	CVG102GD $152	CVG102GE $140	CVG102GF $152	CVG102GG $140	CVG102GH $152

PRICE LIST FOR INSTRUTECH VACUUM INSTRUMENTATION - CONVECTION GAUGES (continued)

CVG "Worker Bee" Accessories							P/N	Price
Cable, CVG VGC-301 Controller, 10ft (3m)							CB421-1-10F	$77
Cable, CVG VGC-301 Controller, 25ft (8m)							CB421-1-25F	$94
Cable, CVG VGC-301 Controller, 50ft (15m)							CB421-1-50F	$121
Cable, CVG VGC-301 Controller, over 50ft (15m), Over 50ft (15m) up to 100ft (30m). Specify length in xxF or yyM							CB421-1-xxF	$72 + $1.10/ft
(Cables above connect an InstruTech CVG or GP 275 gauge to an InstruTech VGC-301 or GP 375 Controller.)								
Mating Connector Kit for CVG "Worker Bee" gauge (special molded connector for fabricating your own cable)							CK431-01	$22

CVM-211 "Stinger" Convection Vacuum Gauge Module – 3 digit Torr/mTorr display, Log Linear analog output, one process setpoint relay.

Model No.	Fitting Description	⅛" NPT - ½ Tube	NW16	NW25	NW40	1.33 CF	2.75 CF	¼" Cajon® 4VCR	½" Cajon® 8VCR
CVM-211	Convection	CVM211GAL $290	CVM211GBL $315	CVM211GCL $325	CVM211GDL $335	CVM211GEL $325	CVM211GFL $335	CVM211GGL $320	CVM211GHL $335

CVM-211 "Stinger" Convection Vacuum Gauge Module – 3 digit Torr/mTorr display, Non-Linear analog output, one process setpoint relay.

CVM-211	Convection	CVM211GAA $290	CVM211GBA $315	CVM211GCA $325	CVM211GDA $335	CVM211GEA $325	CVM211GFA $335	CVM211GGA $320	CVM211GHA $335

The CVM-211 "Stinger" Convection Vacuum Gauge Modules are also available with bar/mbar Display. To order specify part number above with suffix -BL for **Log Linear analog output**. Or suffix -B-NL for **Non-Linear analog output**. **Prices are the same as above**

CVM-201 "Super Bee" module, with 4-digit LCD display, linear and non-linear analog outputs, RS-232/485 interface, two process setpoint relays. User Programmable in Torr/mTorr, mbar, or PA

Model No.	Fitting Description	⅛" NPT - ½ Tube	NW16	NW25	NW40	1.33 CF	2.75 CF	¼" Cajon® 4VCR	½" Cajon® 8VCR
VGC-301	Convection Controller	CVM201GAA $435	CVM201GBA $460	CVM201GCA $470	CVM201GDA $480	CVM201GEA $470	CVM201GFA $480	CVM201GGA $470	CVM201GHA $480

VGC-301 Controller, 4-digit LCD display, selectable linear or non-linear analog outputs, RS-232/485 interface, two process setpoint relays, powered by 100-240VAC or 12-30VDC. Includes power cord. See accessories below for gauge interconnecting cable. Programmable in Torr/mTorr, mbar, or PA

						P/N		Price
						VGC 301 A		415
VGC-301 Accessories								
Cable, CVG VGC-301 Controller, 10ft (3m)							CB421-1-10F	$77
Cable, CVG VGC-301 Controller, 25ft (8m)							CB421-1-25F	$94
Cable, CVG VGC-301 Controller, 50ft (15m)							CB421-1-50F	$121
Cable, CVG VGC-301 Controller, over 50ft (15m), Over 50ft (15m) up to 100ft (30m). Specify length in xxF or yyM							CB421-1-xxF	$72 + $1.10/ft

JIG4500 Full Range Vacuum Controller

The JIG4500 ionization gauge controller replaces the successful JIG4400. This controller provides superior reliability and accuracy at a very affordable price. This controller operates and displays one hot cathode ionization gauge tube and two separate thermocouple tubes simultaneously. Standard features include RS-232 computer interface, degas timer and four separate 3A set points adjustable from 1 to 1 x 10^{-10} Torr. An analogue recorder output monitors the vacuum. The JIG4500 provides 50 Watts of resistive degas power. The standard unit includes 19 inch rack mount brackets. JIG4500 controller is clear, concise, and easy to operate with or without the instruction manual. The JIG4500 is designed for maximum precision, reliability, and durability. Each unit is subjected to stringent quality control measures. It is calibrated before and after a 48 hour burn-in, it is then adjusted for operation with a Bayard Alpert ion gauge tube.

JIG4500 Features

- Continuous vacuum reading from 1 to 1x 10^{-10} Torr
- Simultaneous display of all gauges
- Automatic pressure range changing
- Runs two thermocouple gauges displayed on separate bar graphs.
- Timed resistive degas
- RS-232 computer interface
- User adjustable sensitivity, emission current & degas time
- Recorder output
- Easy to operate controls
- 19 inch rack mounting option included
- THREE YEAR WARRANTY
- 48 hour burn-in

JIG4500 Specifications

• Ion Gauge Tube	Bayard-Alpert
• T/C Gauge Tube	VR6-M
• Degas Power	50 Watts
• Degas Timer	0 - 99 minutes
• Pressure range	1 to 1 x 10^{-10} Torr
• Emission current	Adjustable 0.1 to 25 mA
• Sensitivity	Adjustable 1 to 64
• Analogue output	0 to 10 VDC
• Set points	4 x 3A @ 115VAC SPDT relays
• Mains power	115 or 230 VAC 50/60Hz
• Dimensions	3.5" (88.9 mm) x 10.5" (266.7mm) x 15" (381mm)

Warranty - Our ion gauge controllers are guaranteed for **three years** against defects in parts, materials and workmanship. Any misuse or attempts to repair or reprogram the controller during the warranty period will void the warranty. No other warranties are expressed or implied.

JIG4500 Controller with rack mounts fitted

JIG-4500 Digital Ion Gauge Controller Price includes controller, four set points, RS-232 Computer interface, Power cord, 19" Rack mount option and instruction manual.. . . . . **Price $1,210.00**

VRC-6M **VRC-6M Thermocouple Gauge Tube**, Specify fitting NW16, NW25 or CF34 (1.33" OD). . . . . **Price $111.00**

JIGT-G100 **BA Glass Ion Gauge Tube** (1" Tubulation).. . . . . **Price $130.00**

JIGT-F100 **BA Glass enclosed Ion Gauge Tube** CF70 (2.75" OD Conflat). . . . . **Price $182.00**

VIG-45 **BA Nude Ion Gauge Tube** CF70(2.75" OD Conflat). . . . . **Price $400.00**

JTVC-4500 **Thermocouple Gauge Cable** (10 feet). . . . . **Price $39.00**

JTVC-4500-(x) Additional cable added to JTVC-4400, specify length with suffix -x (**Extra ft**). . . . . **Price $40.00 + $2/ft**

JIGC-10TN **Ion Gauge Cable for JIG2200, JIG4500, JIG6600, tubulated gauge** (10 feet). . . . . **Price $138.00**

JIGC-10-TN(x) Additional cable added to JIGC-10TN, specify length with suffix -x (**Extra ft**). . . . . **Price $150.00 + $3.50/ft**

JIGC-10N **Ion Gauge Cable for JIG2200, JIG4500, JIG6600, for nude ion gauge**, non bakeable.. . . . . **Price $135.00**

JIGC-10B **Ion Gauge Cable for JIG2200, JIG4500, JIG6600, for nude ion gauge**, bakeable 200ºC.. . . . . **Price $149.00**

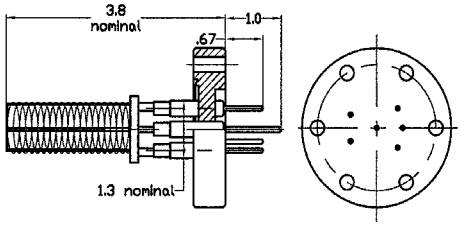
JCVC-10 **Convection Gauge Cable** (10 ft). **$50.00**

JCVC-6600-(x) Additional cable added to JVCC-6600, specify length with suffix -x (**Extra ft**).. . . . . **Price $55.00 + $2/ft**

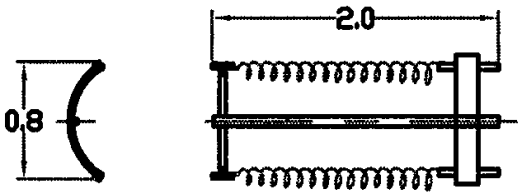
ALL PRICES IN US DOLLARS

Gauge Tubes - IONISATION GAUGES - NUDE

Model / Specifications	VIG41 8130T	VIG42 8130T	VIG43 8130	VIG44 8130	VIG45 8140	VIG46 8150	VIG47 8150T	VIG48 8140T
Sensitivity for N2	25/Torr	25/Torr	25/Torr	25/Torr	10/Torr	10/Torr	10/Torr	10/Torr
X-ray limit	2×10^{-11} Torr	2×10^{-11} Torr	2×10^{-11} Torr	2×10^{-11} Torr	4×10^{-10} Torr	4×10^{-10} Torr	4×10^{-10} Torr	4×1^{-10} Torr
Operating pressure	1×10^{-3} to 2×10^{-11} Torr	1×10^{-3} to 2×10^{-11} Torr	1×10^{-3} to 2×10^{-11} Torr	1×10^{-3} to 2×10^{-11} Torr	1×10^{-3} to 4×10^{-10} Torr	1×10^{-3} to 4×10^{-10} Torr	1×10^{-3} to 4×10^{-10} Torr	1×10^{-3} to 4×10^{-10} Torr
De-gas	EB 40W @ 500V	EB 40W @ 500V	EB 40W @ 500V	EB 40W @ 500V	I^2R 7A @10V	EB 40W @ 500V	EB 40W @ 500V	I^2R 7A @10V
Filament	2 x W	2 x W	2 x Thlr	2 x Thlr	1 x Thlr	2 x Thlr	2 x W	2 x W
Mounting Position	Any	Any	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Bakeout temperature	450ºC	450ºC	450ºC	450ºC	450ºC	450ºC	450ºC	450ºC
collector potential	0 Volts	0 Volts	0 Volts	0 Volts	0 Volts	0 Volts	0 Volts	0 Volts
Shield potential	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Grid potential	150 to 180 V	150 to 180 V	150 to 180 V	150 to 180 V	150 to 180 V	150 to 180 V	150 to 180 V	150 to 180 V
Filament current	4 to 6 A	4 to 6 A	4 to 6 A	4 to 6 A	4 to 6 A	4 to 6 A	4 to 6 A	4 to 6 A
Filament voltage	3 to 5 V	3 to 5 V	3 to 5 V	3 to 5 V	3 to 5 V	3 to 5 V	3 to 5 V	3 to 5 V
Filament to ground volts	30 V	30 V	30 V	30 V	30 V	30 V	30 V	30 V
Vacuum connection	70mm (2¾")	NW40	70mm (2¾")	NW40	70mm (2¾")	70mm (2¾")	70mm (2¾")	70mm (2¾")
PRICE US $	**$400.00**	**$400.00**	**$400.00**	**$400.00**	**$400.00**	**$400.00**	**$400.00**	**$400.00**



Nude Ionization Gauge Tube



Replacement Filament for Nude Ion Gauges

Replacement filaments for Nude Ion Gauges

DESCRIPTION	TO FIT GAUGE TUBE MANUFACTURER						PRICE US $
	GRANVILLE PHILIPS	VARIAN	PERKIN ELMER	VACUUM GENERATORS	DATACOMP ELECTRONICS	OUR PART NO.	
Dual Thoriated Iridium	274-023 274-042 274-058 Fil. # 274025		605-7672		VIG43 VIG44 VIG46	**E274025**	**$ 110.00**
Dual Tungsten	274-022 274-041 274-050 274-057 Fil. # 274024		605-7673		VIG41 VIG42 VIG47	**E274024**	**$ 95.00**
Single Thoriated Iridium	274-028 274-043 274-053 Fil. # 274029				VIG45	**E274029**	**$ 105.00**
Dual Tungsten				VIG10A VIG17 VIG17M VIG22		**VZWW17**	**$ 150.00**
Dual Thoriated Iridium				VIG18 VIG18M VIG24 VIG24M		**VZTIR23**	**$ 155.00**
Single Thoriated Iridium				VIG8 VIG8KF		**VZIR23**	**$ 135.00**
Dual Thoriated Iridium				VIG21		**VZTTCIR**	**$ 190.00**
Dual Tungsten				VIG20		**VZWW**	**$ 168.00**
1 x Tungsten, 1 x Thoriated Iridium				VIG23		**VZWIR23**	**$ 208.00**

ALL PRICES IN US DOLLARS

Diaphragm Manometer; 1 to 1500 Torr

- **1 to 1500 Torr Range; ± 1 Torr Resolution**
- **0.1 Torr Resolution Available as Option**
- **Available in 1 to 2000 mBar & 0.1 to 200 kPa**
- **316 SS Diaphragm Measures Gas Or Liquid**
- **Dual Set Point Controller With 2 Relays**
- **Easy To Read Large Digital Display**
- **Linear 0 to 1.5 VDC Output; 4-20 mA Optional**
- **Fast Response; Less Than 400 msec. Full Scale**

The VRC Diaphragm Manometers are compact vacuum measurement and control instruments. The sensors are available with either 316 SS or pure silicon diaphragms and any sensor can measure liquid or gas pressure as well as vacuum.

Response time is less than 400 milliseconds for full scale and sensors are available with a variety of flanges including 15mm, VCR, and KF-16. With any sensor, these instruments offer the precision and high resolution of digital electronics at the same price as analogue instruments. Both indicator and controllers are provided in 1/4 DIN enclosures.

The Dual Set Point Controller operates two control relays. Set point values are adjusted from the front panel and displayed on the meter. Push-to-set switches simplify display of the set point pressures. Relays have 3 Amp contacts, SPDT, and have screw terminal connectors on the rear of the instruments.

For applications that require maximum resolution a special display unit is available with a 4½ digit LED display. To specify this feature add to the part number "HI-RES" suffix and add $184.00 to the price.

Pressure Range: 1 to 1500 Torr; ±1 Torr (± 0.1 Torr optional).
Calibration: Any gas, liquid or vacuum compatible with sensor materials.
Accuracy: 1% of reading or 2 Torr.
Response Time: Less than 400 msec. for response to a step change.
Linearity: ±0.15% Full Scale. **Sensitivity:** ±1 Torr.
Analogue Output: 0 to 1.500 Volt into 2000 Ohm load or higher. 2 pin connector included. 4 to 20 mA output in addition to 0 to 1.5 Volt DC
option available.
Transducer: See "ordering Information" below for list of transducers.
Materials: All parts in contact with process are 316 or 304 SS, or silicon.
Set Point Range: Full Scale, 1 to 1500 Torr. Repeatability: ± 2 Torr.
Sensor Internal Volume: 1.25 ml for SS; 0.5 ml for Silicon.
Line Regulation: ± 20% change in line voltage produces less than 1% change in reading.
Line Power: 115 VAC, 50/60 Hz; 230 VAC optional at no additional cost.
Wattage: Less than 1 Watt for indicator; 2 Watts for controller.
Temperature Effects: When changes occur in ambient temperature between 0ºC and 50ºC, reading will change no more than :±0.02% per ºC
Bakeout Temperature: Gauge tube can be baked to 100ºC (212ºF)

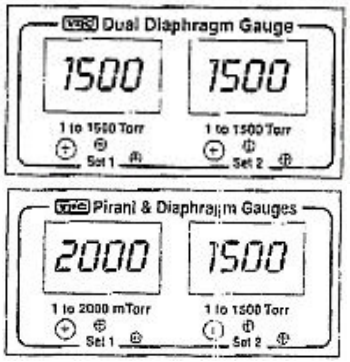
in air or vacuum.
Dimensions: DIN enclosure: 92x92 mm panel cutout, 122 mm deep.
Mounting: Panel mounting hardware is standard. Bench mount and portable cabinets are also available, see page 32.
Transducer Cables: 10 ft. (3m) attached.
Extension Cables: Change sensor cable length without recalibration.
Extensions to 500 ft. (150m) can be used.
Line Cord: 3 wire, 65 inch (170 cm) attached.
Net Weight: Indicator 1lb. 2 oz. (0.5 kg); Controller 1lb. 6 oz. (0.6 kg)
Shipping Wt.: Indicator 2 lbs. 8 oz. (1.1 kg); Controller: 3 lbs. (1.3 kg)
Dual Set Point Controller With Digital Display in *¼ DIN enclosure.*
CSA approved. Transducer not included. **P/N: VR902094 $810.00**
Digital Indicator only in *¼ DIN enclosure.* CSA approved. Transducer not included. **P/N: VR902093.. . . . . $572.00**
High Resolution Option For higher resolution, instruments can be ordered with a 4½ digit LED display for resolution of ±0.1 Torr. Add
suffix "Hi-Res" and **P/N VR801302.. . . . Additional cost $270.00**
4 to 20 mA and 0 to 10VDC Output in addition to 0 to 1.5 VDC analogue output. **P/N: VR801085 . . . . . add $300.00**
Calibrator for 1 to 1500 Torr Instruments This compact and easy to use electronic calibrator allows you to adjust both zero and full scale of 1 to 1500Torr instruments without the use of a vacuum system. **P/N: VR912027**
. . . . . $306.00
Transducer with Stainless Steel Diaphragm outer case, connector pins, and wetted parts 316 stainless steel. Maximum bakeout temperature 125ºC.
Stainless Steel Diaphragm with ¼ in. NPT. P/N: VR912022
. . . . . $513.00

Stainless Steel Diaphragm with VCR-8 Female, P/N: VR902050 . . . . . $651.00
Stainless Steel Diaphragm with VCR-4, P/N: VR912219 . . . . . $579.00
Stainless Steel Diaphragm with NW-16 Flange, P/N: VR912151 .. . . . . $579.00
Stainless Steel Diaphragm with NW-25 Flange, P/N: VR912117 $579.00
Stainless Steel Diaphragm with 1⅓ in. Conflat®,P/N: VR912191 . . . . . $579.00
Stainless Steel Diaphragm with ½ in. OD Tube, P/N: VR912210 . . . . . $579.00

Transducer with Silicon Diaphragm, body is 304 SS, connector pins are solder plated 52 alloy. Maximum bakeout temperature 125ºC.
Silicon Diaphragm With ⅛ in. NPT Male Thread, P/N: VR912091 . . . . . $322.00
Silicon Diaphragm With ½ in. OD Tube, P/N: VR912211 $373.00
Silicon Diaphragm With NW-16 Flange, P/N: VR912023 $373.00

Silicon Diaphragm With NW-25 Flange, P/N: VR912119.$373.00
Silicon Diaphragm With 1⅓ in. Conflat® Flange, non-rotatable, P/N: VR912026 . . . . . $373.00
Silicon Diaphragm With VCR-4 Fitting, P/N: VR912025 .$418.00
Silicon Diaphragm Transducers with All Stainless External Parts for outdoor applications or wherever the use of 304 SS is appropriate. All external parts and connector pins are 304 SS.
Add SS prefix to tube P/N and to tube price: . . . . . add $65.00

It's not just pirani gauges that are available in dual options:



- Available in Torr, mTorr, mbar or Pascal
- Resolution of ± 1mT or ± 1 Torr over Entire Range
- Easy to Read 3½ Digit Backlit LCD Display
- Adjustable Set Point and Relay for Process Control
- Linear DC Output for PLC or DCS is Standard
- Change Cable Length without Re-calibrating
- ⅛ DIN Enclosure; Bench or Panel Mount

Diaphragm Gauge Specifications

Pressure Range: 1 to 1500 torr
Calibration: any gas, liquid or vacuum compatible with sensor materials
Accuracy: 1% or reading or 2Torr
Response Time: Less than 400msec. for response to a step change
Analog Output: 0 to 1,500 Volt into 2000 Ohm load or higher
Transducer: please call Datacomp Electronics for details
Materials: All parts in contact with process are 316 or 304 SS, or silicon
Set Point Range: Full Scale, 1 to 1500 Torr, Repeatability ± 2 Torr
Sensor Internal Volume: 1.25 ml for S; 0.5ml for Silicon
Temperature Effects: When Changes occur in ambient temperature between 0°C and 50°C, reading will change no more than ± 0.02% per °C

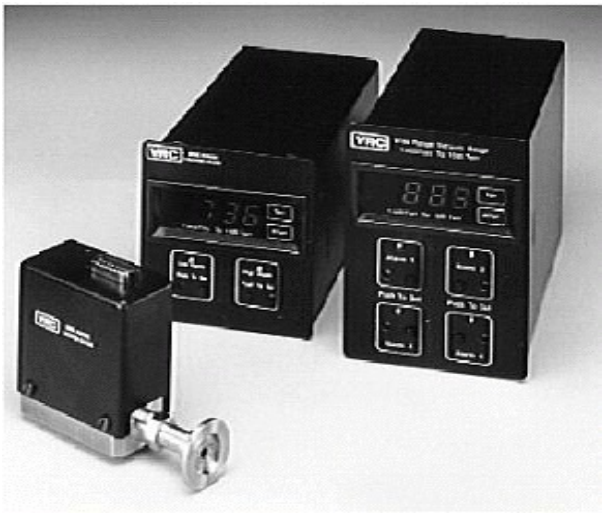
Two Channel Diaphragm 1 to 1500 Torr in ⅛ DIN enclosure. Each channel includes 3½ place backlit LCD display, linear analog output 0 to 1.5 VDC and an adjustable set point with relay. P/N 902306. . . . . $835

Common Specifications

Bakeout Temperature: Standard gauge tube can be baked to 100°C (212°F) in air or vacuum . For 250°C (482°F) bakeout, phone Datacomp Electronics.
Dimensions: ⅛ DIN 96 x 48 x 188mm.
Mounting:⅛ DIN enclosure. Jack screws for panel mounting are included.
Gauge Tube Cables: Up to 500 ft. See Ordering information.
Extension Cables: Change gauge tube cable length without recalibration. Extensions to 500ft. (150m) can be used.
Net Wt: w/o gauge tube is 1lb, 6oz. (0.6 kg)
Shipping Wt: w/o gauge tube is 3lbs. (1.4kg)
Power: Gauges operate from 12 to 35 VDC power, 150mA. Optional power supply available for 115/230 V, 50/60 Hz: P/N 902221
Relay: SPDT contacts rated for 3A @ 115 VAC, non-inductive
Wattage: Less than 1 Watt for indicator, 2 Watts for controller

Dual gauge with one Pirani and one Diaphragm Gauge in ⅛ DIN enclosure, separate 3½ place backlit LCD display, analog outputs and adjustable set points for each gauge P,N: 902307. . . . . $835

Wide Range Diaphragm Manometer - 1 mTorr to 1500 Torr



0 to 10 VDC and 4 to 20 mA Outputs

The standard instrument provides 0 to 2 VDC and 0 to 1.5 VDC outputs. In addition to these standard outputs. the optional version provides 2 programmable analogue outputs of 0 to 10 VDC or 4 to 20 mA.

- Wide Range: 10^{-3} to 1500 Torr
- Available in .001 to 2000 mBar & 0.1 to 200 kPa
- Linear with any gas from 2 to 1500 Torr
- Up to 4 adjustable set points and 3 Amp relays
- 0 to 2 VDC, 0 to 10 VDC, and 4 to 20 mA outputs
- Linear analogue outputs for computer interface
- Large easy to read LED display
- Stainless steel or silicon diaphragms available
- Bench or panel mount enclosure
- 400mSec response time from 2 to 1500 Torr
- 1.25 sec. Response time from 1 to 2000 mTorr
- All cables and mounting hardware included
- Extension cable up to 250 feet available.

Torr, milliBar, Pascal

The VRC Wide Range Manometer reads directly in Torr and mTorr, but ranges of .001 to 2000 milliBar and 100 Pascal to 200 kPascal are available at no extra charge.

Fast Response

The VRC Wide Range Manometer uses a fast response diaphragm sensor to provide high accuracy measurements that are unaffected by gas composition from 2 to 1500 Torr. At pressures from 2000 mTorr to one mTorr the easy to read LED display is driven by a rugged Pirani sensor that is mounted in the transducer next to the Diaphragm sensor. The Diaphragm and Pirani sensors are both mounted in the same transducer body, and the diaphragm sensor is easily replaceable in the field.

Unaffected By Sensor Orientation

This durable process control instrument uses a transducer body machined from a solid block of stainless steel and, unlike convection gauges, our wide range gauge accuracy is not affected by the transducer orientation or gas composition.

Four Set Points for Process Control

The standard VRC Wide Range Manometer includes 2 adjustable set points, while the optional version provides 4 adjustable set points for process control. These process control set points have front panel LED indicators and can be set anywhere in the range of the instrument. Each set point drives its own SPDT relay. Contacts are rated 3 amps @ 220 V, non-inductive.

Diaphragm Manometer Applications

Crystal Growing

Like many vacuum processes, crystal growing is a two step operation that has traditionally required more than one gauge for control. First, evacuation with a two stage pump to 10 to 15 mTorr (1 to 2 Pascal) removes oxygen and water vapor. Then, the furnace is back filled with argon to approximately 200 Torr (2500 Pa). The wide range diaphragm manometer was designed for processes such as this that require accurate and repeatable measurements at pressures many decades apart.

Lamp Manufacture

Measure pump down of mechanical booster pump from atmosphere to less than 5 mTorr (1 Pa) and then monitor pressures of back fill gas mixture of argon, neon, and krypton to 600 Torr (80,000 Pa).

LPCVD

Evacuate furnace to less than 20 mTorr (2 Pascal), close valve in roughing pump line and monitor rate of pressure rise to check for leaks. If rate of rise is satisfactory. then back fill with process gas mixture to between 2 and 10 Torr (200 and 1200 Pascal).

SPECIFICATIONS

Standard & Auxiliary Output Model	1 to 2000 milliTorr Pirani Sensor	2 to 1500 Torr Diaphragm Sensor
Sensor Type	Platinum alloy Pirani	Silicon or 316 SS Diaphragm
Resolution & Repeatability	± 1 mTorr	± 1 Torr
Linearity	3% of Reading	0.15% of Full Scale
Accuracy	3% of Reading or 3 mTorr	1% of reading or 2 Torr
Response Time	less than 1.25 seconds	Under 400 msec. for 100% of step change
Hysteresis (to prevent chatter, up to 5% available)	less than 2 mTorr minimum	less than 2 mTorr minimum
Analogue Output (Standard Model)	0 to 2.000 VDC	0 to 1.500 VDC
Analogue Output (Auxiliary Output Model)	0 to 2.000 VDC plus a 2nd output programmable as 0 to 10 VDC or 4-20 mA	0 to 1.500 VDC plus a 2nd output programmable as 0 to 10 VDC or 4-20 mA
Maximum Pressure without Calibration Change	60,000 Torr (1250 PSIG)	2,300 Torr (30 PSIG)
Effect of Ambient Temp. Changes from 0ºC to 50ºC Reading will change less than:	0.2 mTorr per ºC at 50 mTorr 4 mTorr per ºC at 900 mTorr	± 0.02% per ºC

SPECIFICATIONS (CONTINUED)

Standard & Auxiliary Output Model	1 to 2000 milliTorr Pirani Sensor	2 to 1500 Torr Diaphragm Sensor
Maximum Transducer Bakeout Temperature	100º C	
Display	3½ Digit, LED character height 0.43 inch (11mm)	
Set Points and Relays	2 or 4 independent set points with front panel LED indicators nd 2 or 4 SPDT relays. 3 Amp @ 220 VAC, non-inductive. Front panel adjustable over 100% of range.	
Transducer Orientation	Calibration is not affected by orientation	
Line Voltage and Power	95 to 120 V, 50/60 Hz standard, 220 V available. 5 watts with both relays energized	
Line Cord	65 inch (1.7 m) attached, 3 conductor. CSA approved	
Bench or Panel Mounting	Panel cutout: 3.62 inch W x 4.68 inch H (92mm x 119mm). Panel mount jack screws included.	
Transducer Cables	10 ft (3 m) with connectors both ends. Cables up to 500 ft (150 m) available.	
Weight with Transducer	Net 5 lb (2.3kg); Shipping 6.5 lb (3 kg); add 1 lb (.3kg) for Auxiliary Output model.	

Ordering Information

Display Units Standard & Auxiliary Output Units

Standard Wide Range Gauge Display Units

Digital display unit with 2 set points and 2 analog outputs; 0 - 1.5 & 0 - 2 VDC. ¼ DIN cabinet suitable for bench or panel mounting. 115V AC, CSA approved. Line cord and 3 metre (10ft) transducer cable included. Transducer not included. One transducer required.

1 mTorr to 1500 Torr, P/N VR902056 **$1,046.00**

Wide Range Display Units with Auxiliary Outputs

Digital display unit with 4 set points and 4 analog outputs; 0 - 1.5 & 0 - 2 VDC plus 0 - 10V DC and 4-20 mA. ¼ DIN cabinet suitable for bench or panel mounting. 115V AC, CSA approved. Line cord and 3 metre (10ft) transducer cable included. Transducer not included. One transducer required.

1 mTorr to 1500 Torr, P/N VR902081 **$1,382.00**

Calibrator

For Wide Range Diaphragm Manometer. These easy to use electronic calibrators allow you to adjust both zero and full scale of the Display Unit without the use of a vacuum system.

P/N VR912110 **$700.00**

Transducers

Mini Transducers with Silicon Diaphragm

The new Mini Transducers operate with all models of VRC Wide Range Manometers regardless of date of manufacture. Transducer body is 304 stainless steel. Pirani gauge materials include 304 SS, platinum alloy and glass to metal seals. Diaphragm sensor is 304 stainless steel except for the diaphragm itself which is pure silicon metal.

⅛ **inch NPT,** P/N VR902058-mini **$717.00**
½ inch OD tube, P/N VR902055-mini **$717.00**
15mm OD tube, P/N VR902122-mini **$717.00**
NW16 flange, P/N VR902068-mini **$783.00**

NW25 flange, P/N VR902147-mini **$783.00**
VCR-4, P/N VR902085-mini **$812.00**
VCR-8, P/N VR902091-mini **$812.00**
VCO-8, P/N VR902146-mini **$812.00**
CF34 (1.33") flange, P/N VR902153-mini **$783.00**
CF70 (2.75") flange, P/N VR902210-mini **$783.00**

Mini Transducers with 316 Stainless Diaphragm

Transducer body is 304 stainless steel. Pirani gauge materials include 304 SS, platinum alloy and glass to metal seals. Diaphragm sensor is 316 stainless steel including the diaphragm itself.

⅛ **inch NPT,** P/N VR902057-mini **$908.00**
½ inch OD tube, P/N VR902052-mini **$908.00**
15mm OD tube, P/N VR902121-mini **$908.00**
NW16 flange, P/N VR902067-mini **$966.00**
NW25 flange, P/N VR902151-mini **$966.00**
VCR-4, P/N VR902051-mini **$994.00**
VCR-8, P/N VR902092-mini **$994.00**
VCO-8, P/N VR902150-mini **$994.00**
CF34 (1.33") flange, P/N VR902154-mini **$966.00**
CF70 (2.75") flange, P/N VR902211-mini **$966.00**

Replacement Transducers

Replacement Sensors for Mini Transducers

Replacement Pirani Sensors for Mini Transducers, Part No. VR902300 **$117.00**

Replacement Silicon Diaphragm Sensors for Mini Transducers, Part No. VR902301 **$275.00**

Replacement Stainless Steel Diaphragm Sensors for Mini Transducers uses the same interchangeable SS diaphragm sensor for field replacement as those shipped in 1998 or before. Material is 316 stainless steel. P/N VR902079 **$478.00**

Replacements for other Transducers shipped in 1998 or before: In the past, VRC has used different styles of replacement sensors in the Wide Range Vacuum Gauge Transducer. The part numbers listed below use an O-ring seal and will fit all Wide Range Transducers regardless of the year of manufacture. The older style sensors with pipe thread are no longer available.

Replacement Pirani Sensors. P/N VR902077-OR **$131.00**

Replacement Silicon Diaphragm Sensors. P/N VR902078-OR **$290.00**

Thermocouple Vacuum Gauges; 1 to 1000 mTorr

Reliable T/C Gauge 1 to 1000 mTorr (Microns)

Indicator Only or Indicator with 2 Set Points

Stainless Tubes & Special Flanges Available

Stem and Flanges 300 Series Stainless Steel

Operates With Power From 90 to 240 V, 50/60 Hz

0 to 5 Volt Output For Computer 1/0 or Control

Fits Same Cutout As Hastings, TeleVac &Varian

Use With VRC-6 or Hastings DV-6 Gauge Tubes

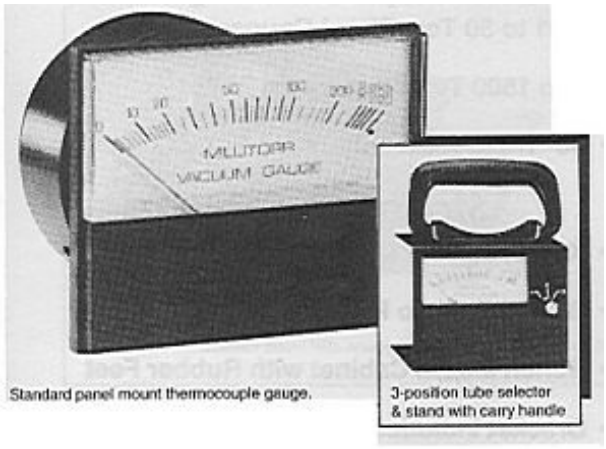
VRC's thermocouple vacuum gauge is a simple and low cost instrument for vacuum measurement in the popular I to 1000 mTorr range (microns). It operates with any line voltage from 90 to 240V at 50 or 60 Hz, and can be used with our VRC-6 or Hastings DV-6 gauge tubes. A 0 to 5 VDC analog output is standard on both the indicator and dual set point controller models.

Indicator: Panel mounting is standard. Four studs provided for panel mounting in 2.89 in. (72 mm) diameter

Dual set point controller provides 2 adjustable set points for control in addition to the 0 to 5 VDC analog output. Shown here are the standard ⅛" NPT gauge tube and the option al KF-16 flange model. All wetted parts in all VRC tubes are 300 series stainless steel

Thermocouple Gauge Tube

The VRC-6M and 6R are direct plug-in replacements for the Teledyne-Hastings DV-6M and DV-6R gauge tubes. No adjustment to your instrument is required; just plug them in. These gauge tubes are tested to 5000 PSIG for operation up to 1250PSIG without damage There is no fragile plastic header, and no easy-to-break plastic key. The result of 30 years of vacuum gauge experience, all VRC tubes have stainless steel bodies with heavy plated metal key and connector pins. For outdoor applications select our 'R' version which has stainless steel connector pins as well as our standard all stainless steel body.

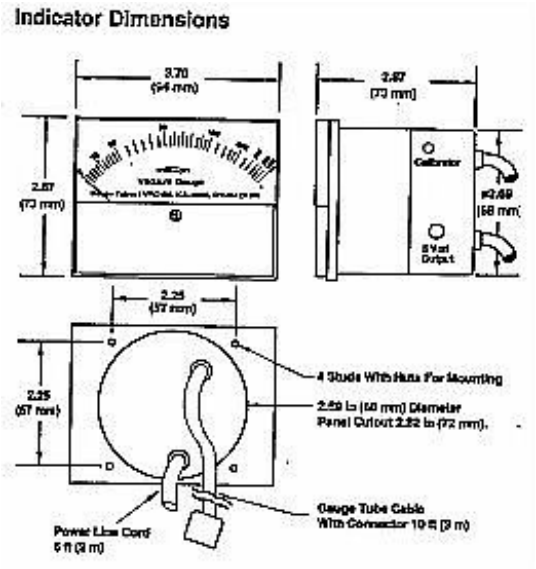


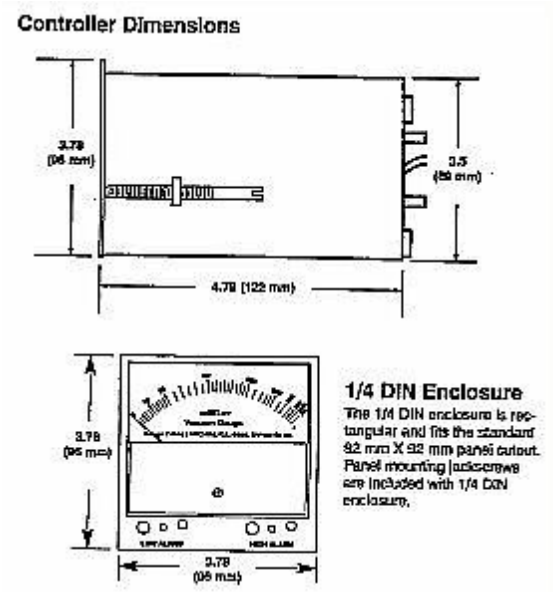
Specifications
Pressure Range: 1 to 1000 milliTorr (1 to 1000 Microns).
Calibration: Air or nitrogen.
Accuracy: Better than ± 1 mTorr from 1 to 20 mTorr. Better than 5**%** from 20 to 1000 mTorr.
Re Time: 1 mTorr up to atmosphere: 1 second from atmos. down to 1 mTorr: 1 0 seconds.
Analog Output: 0 to 5 VDC for computer interface or control, 10 K ohms minimum.
Gauge Tube: Gauge tubes available with 1/8 inch NPT, KF-16, VCR-4, 1.33 OD CF flanges and all stainless steel bodies. This instrument also operates with Hastings DV-6 thermocouple gauge tubes.
Bakeout Temperature: Gauge tube can be baked to 100 OC (212 OF) in air or vacuum. Line Power: Operates with any voltage from 90 to 240 V, 50 or 60 Hz.
Line Regulation: Reading changes less than ±0.3% for line volte chan e from 90 to 240 Volts.

Power Consumption: Less than 2 wafts.
Relays on Controller Model: Separate relays for each set point. Form C, SPDT, contacts rated 3 amps non-inductive at voltages up to 250 VAC.

Mounting

panel cutout. Stand and handle optional.
Controller: 1/4 DIN panel mount is standard. Jack screws included. Handle is optional.
Gauge Tube Cables: 1 0 ft. (3 m) cable with connector provided. Extension cables up to 200 ft. (60 m) are available.
Line Cord: 6 ft. (2 m) 3 wire line cord provided.
Net Weight: Indicator: 0.5 lbs. (0.2 kg); Controller: 1 lb. 6 oz. (0.6 kg).
Shipping Weight:
Indicator: 2 lbs. (0.9 kg); Controller: 3 lb. (1.4 kg).




Controller Dimensions
3.78 (96 mm)
3.5 (89 mm)
4.78 (122 mm)
3.78 (96 mm)
3.78 (96 mm)
1/4 DIN Enclosure
The 1/4 DIN enclosure is rectangular and fits the standard 92 mm X 92 mm panel cutout. Panel mounting jackscrews are included with 1/4 DIN enclosure.

Dual Set Point Controller
Thermocouple gauge, 1 to 1000 mTorr range with 0 to 5 VDC analog output plus 2 adjustable set points each with its own SPDT relay contacts rated 3 Amps up to 220 VAC non-inductive. Operates from any line power between 90 and 240 volts, 50 or 60 Hz. 1/4 DIN enclosure with panel mounting jack screws included. Gauge tube not included.
P/N: VR902109.....$595

Indicator; 1 to 1000 mTorr Meter
Thermocouple gauge, 1 to 1000 mTorr range with 0 to 5 VDC analog output, operates with any line power between 90 and 240 volts, 50 or 60 Hz. Gauge tube not included. See drawing above for dimensions.
P/N: VR902111.....$301

Bench Mount Stand with Carrying Handle
5.3 inch wide x 4 inch F to B x 4.7 High (6.7 inch handle extended)(134x100x120mm)
P/N: VR902112.....$63

3 Position Thermocouple Gauge Tube Selector Switch
Includes 3 cables 10 ft. (3m) long and 3 connectors. (Gauge tubes not included.) Factory installed when ordered with bench mount stand, otherwise requires .375 inch diameter panel hole.
P/N: VR902113.....$217

Standard Thermocouple Gauge Tubes
All parts in contact with the process are stainless steel: cup, stem, and flange. The connector pins are solder coated kovar.
VRC-6M 1/8" NPT stainless steel body,
P/N: VR912086.....$73
VRC-6M NW-16 stainless steel body,
P/N: VR912096.....$133
VRC-6M NW-25 stainless steel body,
P/N: VR912203.....$133
VRC-6M VCR-4 stainless steel body,
P/N: VR912082.....$153
VRC-6M 1.33" CF stainless steel body,
P/N: VR912083.....$133
VRC-6M 2.75" CF stainless steel body,
P/N: VR912178.....$196

Thermocouple gauge tubes with stainless steel connector pins
For outdoor use or applications that require frequent unplugging of the gauge tube connector. All parts are stainless steel: cup, stem, flange, and connector pins.
VRC-6R 1/8" NPT stainless steel pins & body,
P/N: VR912087.....$138
VRC-6R NW-16 stainless steel pins & body,
P/N: VR912098.....$192
VRC-6R VCR-4 stainless steel pins & body,
P/N: VR912099.....$212
VRC-6R 1.33" CF stainless steel pins & body,
P/N: VR912084.....$192
VRC-6R 2.75" CF stainless steel pins & body,
P/N: VR912213.....$212

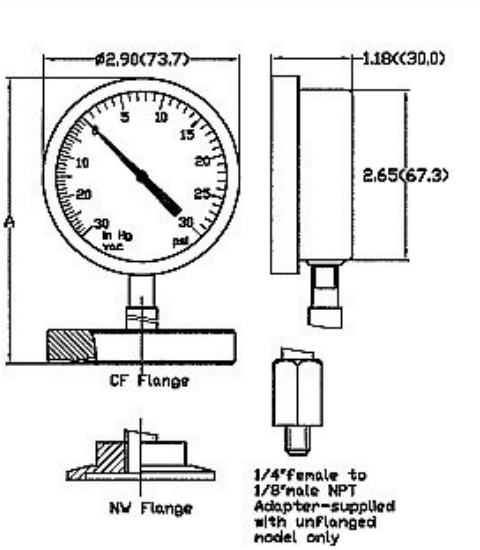
bourdon gauge

Features

Large easy-to read dial
- **30 inch hg to 30 psig range**
- **CF, NW flange or NPT mounting**
- **Stainless steel construction**

Description

Provides a quick visual check of roughing line pressures.



2-½" diameter gauge face
On NPT model only, removable adapter allows either ⅛" or ¼" NPT thread mounting

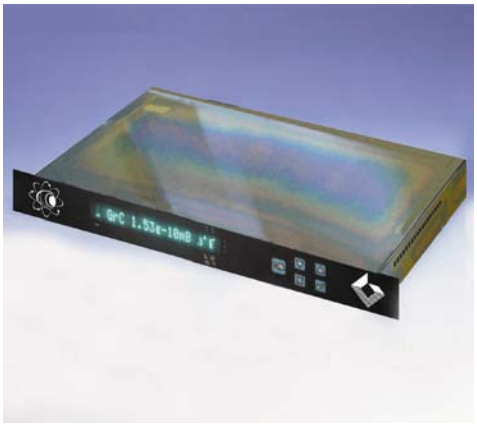
Nominal flange	Flange reference	Flange OD inch	A inch (mm)	Wt Lbs	Part no.	Price Cdn$
Flanged						
1-1/3" CF	F034	1.33	4.0 (101.6)	1	CDGF034	$250.00
2-1/8" CF	F054	2.11	4.2 (106.7)	3/4	CDGF054	$260.00
2-3/4" CF	F070	2.73	4.2 (106.7)	3/4	CDGF70	$280.00
NW16	NW16	1.18	4.2 (106.7)	3/4	CDGNW16	$240.00
NW25	NW25	1.57	4.2 (106.7)	3/4	CDGNW25	$250.00
NW40	NW40	2.16	4.2 (106.7)	3/4	CDGNW40	$270.00
NW50	NW50	2.95	4.2 (106.7)	3/4	CDGNW50	$290.00
Pipe thread						
NPT thread	Includes one 1/4" female to 1/8" male NPT fitting			3/4	CDGNPT4	$210.00

Prices in Canadian dollars, FOB our Guelph warehouse, taxes extra as applicable

IGC3 Ion Gauge - Process Vacuum Controller

The IGC3 features.....

- **Precision HV/UHV ion gauge**
- **Pump Down/Vent control**
- **Multi-step Bakeout control**
- **Timer Function (e.g. TSP)**
- **Intelligent Analogue Output**
- **7 Trips and 2 digital inputs**
- **Full process interlocking**
- **in a 19" 1U format**



The VG Scienta IGC3 ion gauge-based process vacuum controller combines the functionality of several vacuum system controllers into a single easy to use unit, reducing hardware, wiring and cost.

IGC3 combines the latest microprocessor technology with simple, well-established ion gauge power supply design to ensure ease of use, stability and reliability.

Electrical and Mechanical

The IGC3 is housed in a 1U 19" rack mounting unit making for simple mechanical installation. All electrical connections via standard plugs and sockets:

- 1U 19" rack mounting
- Bright VFD display
- User-defined unit naming for ease of identification
- Intuitive 5 button touch panel interface sets all parameters
- Universal "QM" ion gauge connector
- Digital I/O via standard male DB25 connector
- Analogue output via standard mini-jack connector
- RS232/422/485 serial communications via 2x standard RJ45 connector simplifies daisy-chaining

Ion Gauge

Suitable for all HV/UHV ion gauges:

- Emission current settings of 0.1, 0.3, 0.7, 1, 3, 7 and 10mA. User definable min/max. Auto-range mode automatically selects appropriate emission for pressure range
- 7 degas levels between 2 and 33W
- User set ramp/soak degas programme
- Sensitivity 1.0 – 99.0
- Supports 2 filaments. Ir/W/Thoria
- User-defined filter response

Trip Outputs

- 4 change-over relays: 1A @ 24Vdc/0.5A @ 115Vac.
- 3 open collector outputs: 150mA @ 24V
- Assignable to ion gauge, bakeout, timer etc. or comms driven (e.g. valve Option Slots)

IGC3 has 2 user-configurable "option" slots which can accommodate:

- Pirani boards. Monitor backing pressure. Supports system pump-down
- Type K thermocouple amplifier. Supports on/off system bakeout control with integrated pressure and external interlocking
- 2 Digital Inputs
- 2 opto-isolated digital inputs
- Provide user-defined external interlock protection of ion gauge, bakeout, pump-down etc.

Pump-Down

- Pump-down a system to user-defined parameters. Auto start of ion gauge with up to 9 attempts
- Vent ion gauge protection

Bakeout

- Ramped temperature control of heaters for gentle bakeout heating/cooling
- Up to 6 steps of up to 99.9hours each
- Fully pressure and interlock protected

Timer

- Timed operation of external devices (e.g. TSP)
- Pressure and interlock protected

Analogue Output

- Sensitivity and emission corrected
- User-definable voltage output range; can be configured for inverted operation
- User-defined pressure range; ideal for pressure/flux monitoring where output can be tailored to match range of interest

Communication

All aspects of IGC3 can be controlled “manually” from the front panel or using serial comms (e.g. from process control software).

- Native MODBUS protocol allows full floating point resolution data transfer. Grouping frequently needed and related parameters together provides optimised data throughput
- "Enhanced" MODBUS allows data to be written to and read from in a single data message, doubling data throughput
- Multi-drop RS232, RS422/485 interfaces as standard. Up to 16 IGC3’s using RS422/485. Up to 8 IGC3’s to a standard PC port using the multi-drop RS232
- Other protocols available

ORDERING INFORMATION

PART CODE TABLE

ZIGC3	Basic IG controller - no pirani
ZIGC3P	As ZIGC3 with std pirani card
ZIGC3PVG	As ZIGC3P with VG pirani adaptor cable
ZIGMP	Pirani module
ZIGMPVG	Pirani module + VG pirani cable
ZIGMTC	Thermocouple module
ZIGMACC	Accessory pack
ZIGMPCAB	Pirani conversion cable only

Millenia 2 Pressure Gauge Controllers — Part Code

IGC3 Intelligent Pressure Gauge Controller. ZIGC3

Pirani Gauge Heads

SKF10 Flange Mounting, 3 mbar to 10^{-3} mbar, bakeable to 50ºC. ZPVGM5KF
34mm OD Conflat Flange Mounting, 3 mbar to 10^{-3}mbar, bakeable to 250ºC.. . . . . ZPVGM92
70mm OD Conflat Flange Mounting, 3 mbar to 10^{-3} mbar, bakeable to 250ºC. ZPVGM2

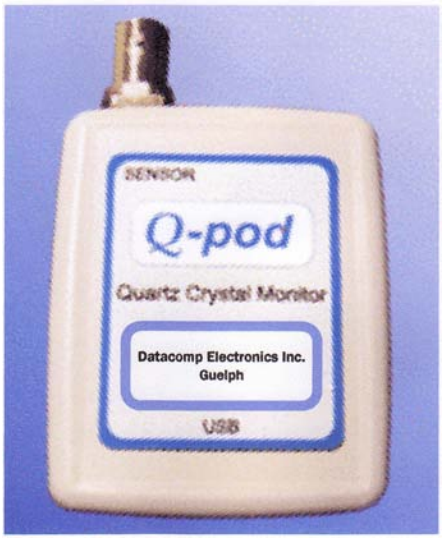
Ionisation Gauge Heads

VIG17, Pressure Measurement to 10^{-11} mbar, Twin W filaments. ZVIG17
VIG18, Pressure Measurement to 10^{-11} mbar, Twin Ir(Thoriated) filaments. ZVIG18
VIG22, Pressure Measurement to 10^{-10} mbar, Twin W filaments. ZVIG22
VIG24, Pressure Measurement to 10^{-10} mbar, Twin Ir(Thoriated) filaments. ZVIG24

Ionisation Gauge Leads

3m Bakeable Ionisation Gauge Lead Assembly. . . ZIPGB3
5m Bakeable Ionisation Gauge Lead Assembly. . . ZIPGB5
7m Bakeable Ionisation Gauge Lead Assembly. . . ZIPGB7
10m Bakeable Ionisation Gauge Lead Assembly. ZIPGB10

THIN FILM DEPOSITION MEASURING EQUIPMENT



Q-pod ™

Thin Film Deposition Rate/Thickness Transducer

- **Simplest & least expensive QCM available anywhere.**
- **Connect directly to your PC's USB ports - up to 8 Q-pods.**
- **Windows®-based software included for operation and data logging.**
- **Weighs less than 2 ounces and small enough to fit in a shirt pocket!**

Description

Looking for a Quartz Crystal Monitor (QCM) to measure thin film deposition rate and thickness? Sigma's new Q-pod™ transducer is your small, inexpensive, and accurate solution.

Setup and operation couldn't be easier. Connect the Q-pod BNC connector to the signal cable from a QCM sensor. On the other side, a standard USB cable connects to your PC. No external oscillator or power source is required.

Load the free Q-pod software on your PC and you're ready to go.

The Q-pod software displays rate, thickness, frequency, crystal life, and a graph of rate versus time, for up to 8 Q-pods simultaneously. Q-pod readings can be logged to disk in spreadsheet friendly comma-delimited format.

Sigma's Q-pod provides the capabilities of a traditional QCM at a fraction of the size and cost.

Specifications

Sensor	Compatible with any QCM sensor
Frequency Range	1 to 10 MHz
Frequency Resolution	0.05 Hz at 6 MHz
Frequency Accuracy	0.002 %
Frequency Stability	± 2 ppm total, over 0º C to 50º C
Input	BNC
Interface & Power	USB, v2.0 or later
Size	1" x 2" x 2.5" (25 x 50 x 64 mm)
Weight	2 oz (32 gm)
Software included	Provides display and setup of all operating parameters
Computer requirements	Any PC running Windows® xP or 2000, with one available USB port for each Q-pod

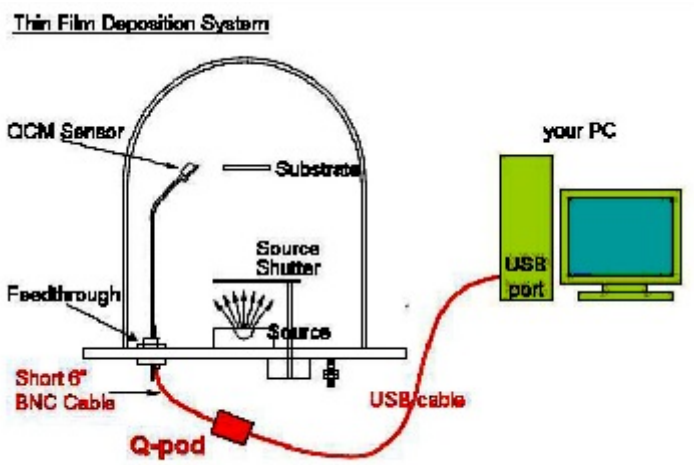
Q-pod™ Application

The block diagram at right shows typical thin film deposition system. A complete Q-pod system consists of the Q-pod, a sensor and feedthrough, and, of course, your computer.

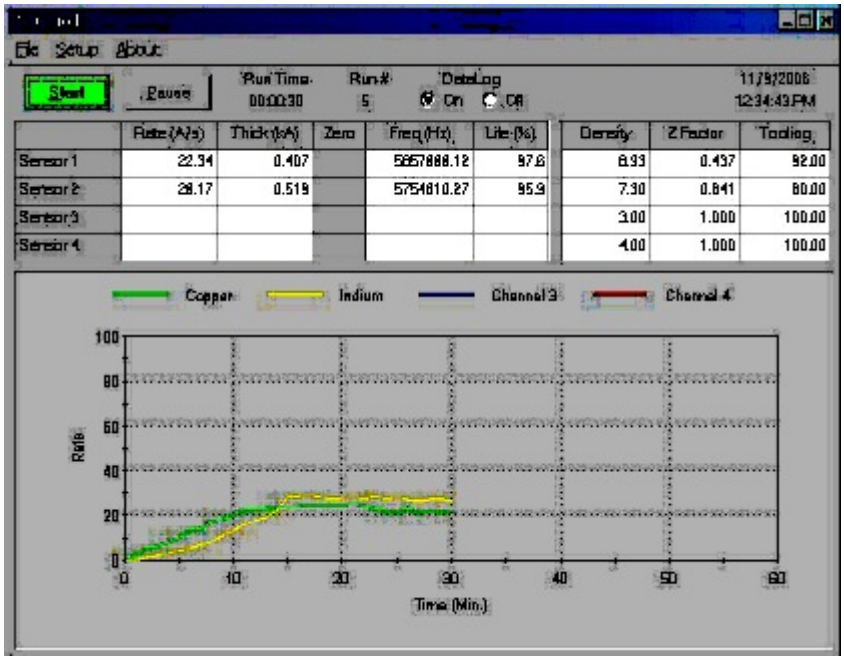
Could we make a QCM any simpler ?

Typical Q-pod system:

Q-pod	transducer
SG700-128	sensor
SG100-000	feedthrough, 1" bolt
SG900-003	crystals, 10-pack



Q-pod™ Software



The screen shot at left shows the main setup and operating screen of the software included with the Q-pod. The software supports up to 8 Q-pods on one PC. (Each Q-pod requires one available USB port.)

Q-pod™ Ordering Information

Q-pod™ QCM Transducer, includes. . . . . US $ 665.00

- Windows based software for setup & operation
- QCM sensor simulator/tester
- 6" (150mm) BNC cable (connects the Q-pod to the feedthrough)
- 10ft (3m) USB cable (connects the Q-pod to your PC).

A full line of QCM crystals, sensors, feedthroughs, and other accessories are available for use with the Q-pod. Complete information can be found in following pages.

SQM-160 Multi Film Rate/Thickness Monitor

- Up to 6 Measurement Channels, two channels standard. An additional four optional
- Displays Thickness and Rate Readings
- RS-232 Port connects to PC, Save Data in Excel Format
- USB or Ethernet optional
- Large Bright LED Displays are visible from across the room
- High accuracy option: 0.03Hz at 10 readings per second
- Pricing starts at $1,595

The SQM160 uses proven quartz crystal sensor technology to measure rate and thickness in thin film deposition processes. Two sensor inputs are standard and four additional sensor inputs are optional. Two recorder outputs provide analog rate and thickness signals.

Sensor inputs can be assigned to different materials, averaged for accurate deposition control in large systems, or configured for a dual sensor. The rate sampling mode allows a shuttered sensor to extend sensor life in high rate processes. Rate displays of 0.1Å/s or 0.01Å/s are user selectable. In addition, Frequency or Mass displays can be selected. Four relay outputs allow the SQM160 to control source or sensor shutters, signal time and thickness setpoints, and signal crystal failure. Digital inputs allow external signals to start/stop and zero readings.

The SQM160 comes with an RS-232 port and Windows® software that allows instrument setup from your computer.
The software can be used to set and store all parameters, operate the instrument, and save process data in an Excel® file format. USB or Ethernet options add to the communications flexibility.

Enhanced software provides a visual display of process data for easy process analysis and documentation. Backup of the SQM160 setup data allows for process consistency.

See sample screen shot at right.

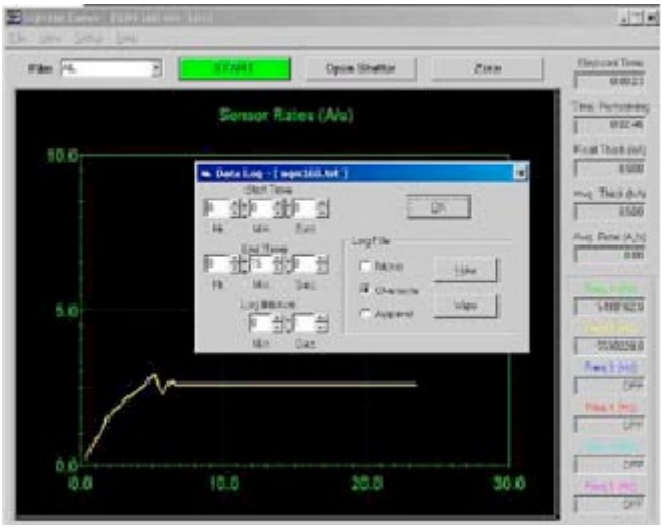
Easy to Use

To start rate and thickness measurements, press Zero to null the last thickness reading, then Shutter to open the source or sensor shutter. The large, bright LEDs simultaneously show thickness and rate readings that are visible from across the room. When the desired thickness is reached, or time has elapsed, the shutter closes and the appropriate front panel annunciators light. Press the Xtal Life button at any time to view the remaining crystal life.

Two menus control instrument setup for the 99 stored films. To access the menus, press Program. Turn the setting knob to select/edit parameters. The main display shows menu prompts, and values are shown in the auxiliary (Time)
display.

High Accuracy, Low Cost

Standard frequency resolution is 0.12Hz at four readings per second. The high accuracy option increases resolution to 0.03Hz at 10 readings per second. Temperature stability is 2ppm over the entire operating range. This combination of high accuracy and high stability are unmatched in an instrument at this price!



SPECIFICATIONS

QCM Sensor Inputs	Standard: 2; optional: 4
Frequency Range	1-10 MHz
Frequency Resolution	Standard: ± 0.12 Hz at 4 readings/sec Optional: ± 0.03 Hz at 10 readings/sec
Frequency Stability	± 2 ppm total, over 0º to 50ºC
Selectable Measurement Period	0.10 to 2 sec (in .05 sec increments)
Measurement Filter	1 to 20 readings
Stored Films	99
Analog Outputs	Two 0 to 10 VDC, rate & thickness
Digital Inputs/Outputs	Two inputs, four relay outputs
Digital Interface	Standard: RS-232 Optional: USB or Ethernet
Power	100-120/200-240 VAC, 50/60 Hz, 20 W
CE Compliance	Class 1 equipment, 73/72/EEC LVD, 89/336/EEC ECD
Electrical Certification	In accordance with the Canadian Electrical Code
Housing/Mounting	1/2-rack cabinet, 3-1/2" high, 89 x 213 x 197mm (3-1/2" x 8-1/2" x 7-3/4")
Weight	2.7 Kg (6 lbs)
Windows Software (included)	Provides remote setup and operation, data-logging functions

ORDERING INFORMATION

Select Options SG-SQM160- X - X - X

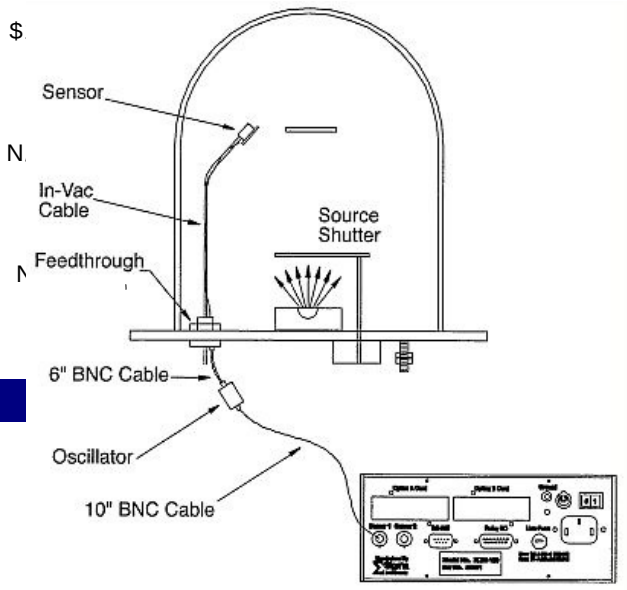
Base Controller
- Standard Resolution S
- High Resolution H

Number of Channels
- Standard 2
- Optional 6

Interface
- Standard RS-232 R
- Optional USB U
- Optional Ethernet E

ACCESSORIES

SG-900-008	19" Rack Mount for one SQM-160	$135
SG-900-014	19" Rack Mount for two SQM-160	$ 70
SG-502-062	4-Sensor Option Card (converts a 2-channel SQM-160 to the 6-channel configuration)	$ 670
SG-900-042	High Resolution Option (converts a standard resolution SQM-160 to high resolution - this option must be factory installed)	$ 400
SG-900-040	USB Option Card	$ 270
SG-900-041	Ethernet Option Card	$ 400



A Typical QCM system consists of the SQM160 monitor (choose your configuration at left) and at least one sensor and feedthrough for each sensor.

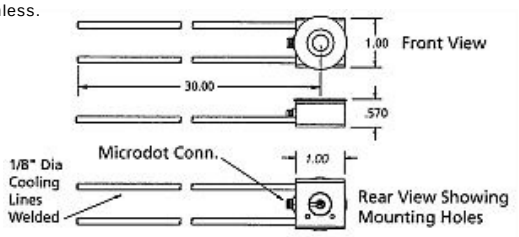
Thin Film Sensors Feedthroughs & Accessories

We offer a complete line of feedthroughs, sensors and cables to satisfy most applications. Our low cost replacement parts are reliable and very competitively priced. Or we can fabricate feedthroughs, sensors and cables to your exact specifications.

Sensors

Standard Single Crystal Sensor Head

The 700-001 is our most popular sensor head. The ⅛" fluid lines can be slipped inside the $^3/_{16}$" lines of the feedthrough, and either welded, brazed or seal with compression fittings. The fluid lines and sensor body are made of 304 stainless.

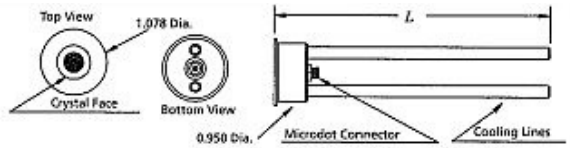


Ordering information

Standard single sensor, ⅛" fluid lines. SG-700-001. . . . . $370.00
Standard single sensor, $^3/_{16}$" fluid lines. SG-700-002. . . . $370.00
non-cooled sensor head, SG-700-128. . . . . $335.00

Right Angle Single Crystal Sensor Head

The fluid lines of the right angle sensor head exit from the rear of the sensor this can be useful in some limited access applications. The electrical Microdot connector also exits from the rear of the sensor.

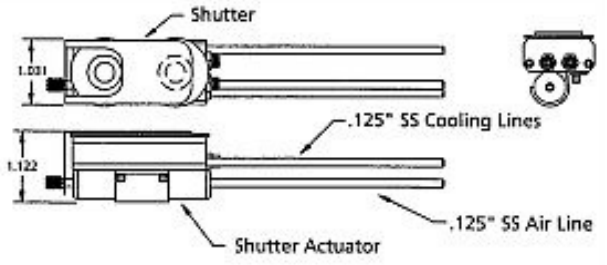


Ordering information

Right angle single sensor, ⅛" fluid lines. SG-700-065. . . . $370.00
Right angle single sensor, $^3/_{16}$" fluid lines. SG-700-066. . $375.00

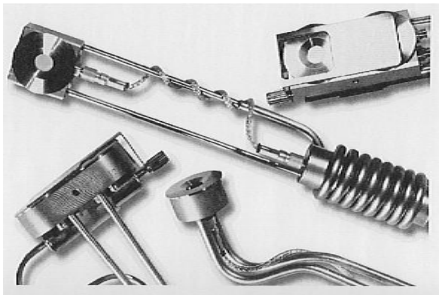
Dual Crystal Sensor, Pneumatic Shutter

The dual sensor head is used in applications where if one crystal fails, the shutter can be activated to allow the second crystal to take over. The simple design of the shutter and actuator results in trouble free operation. This is also available in a single sensor shuttered version. Bakeout temperature of 175ºC max. Actuator operating temperature of 100ºC max.



Ordering information

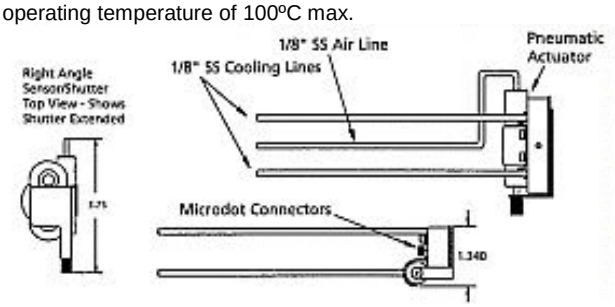
Dual sensor, ⅛" fluid lines, pnu. shutter. SG-700-010. . . $1,575.00
Single sensor, $^3/_{16}$" fluid lines. pnu. shutter. SG-700-088.$1,420.00



Single sensor, ⅛" fluid lines. pnu. shutter. SG-700-011. $1,420.00

Right Angle Dual Crystal Sensor, Pneumatic Shutter

For applications requiring a different profile than our standard dual sensor, we offer the Right Angle Shuttered Dual Sensor. The fluid lines and Microdot connectors exit from the rear of the sensor body. Bakeout temperature of 175ºC max. Actuator operating temperature of 100ºC max.



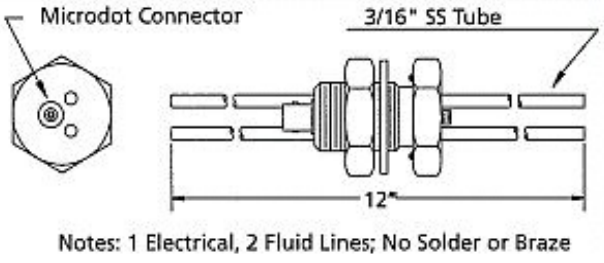
Ordering information

Right angle dual sensor, ⅛" fluid lines. SG-700-062. . . $1,575.00
Right angle dual sensor, $^3/_{16}$" fluid lines. SG-700-063. . $1,575.00

Feedthroughs

1" Bolt Feedthroughs

A 1 inch bolt feedthrough is an inexpensive way to make both electrical and fluid connections to your vacuum system. Do not use for UHV applications.



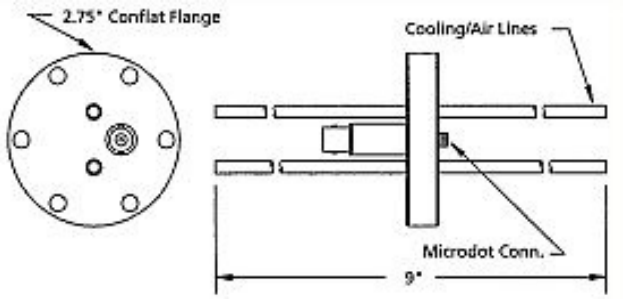
Ordering information

1" bolt with 1 electrical, two $^3/_{16}$" fluid lines. SG-100-001. $325.00
1" bolt with 1 electrical, two $^3/_{16}$" fluid lines, ⅛" compression fittings. SG-100-002. . . . . $390.00
1" bolt with 1 electrical, two $^3/_{16}$" fluid lines, one $^3/_{16}$ air line.

SG-100-007. . . . . $370.00
1" bolt with 2 electrical, two $^{3}/_{16}$" fluid lines, one $^{3}/_{16}$ air line.
SG-100-008. . . . . $555.00

2¾" Conflat™ Feedthroughs

A 2¾ inch Conflat™ type feedthrough will allow more room to insert the sensor, and allow UHV operation. If your needs are not met by a standard product, call our applications engineer for more options.

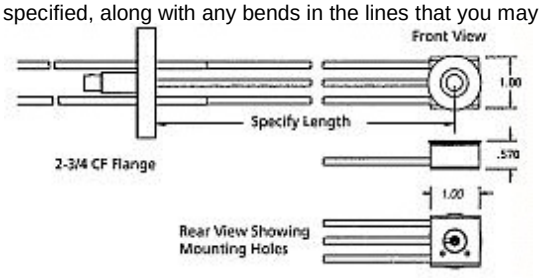


Ordering information

2¾" CF with 1 electrical, two $^{3}/_{16}$" fluid lines. SG-400-001. $330.00
2¾" CF with 1 electrical, two ⅛" compression fittings.
SG-400-002. . . . . $370.00
2¾" CF with 1 electrical, three $^{3}/_{16}$" lines. SG-400-012
. . . . . $430.00
2¾" CF with 2 electrical, three $^{3}/_{16}$" fluid lines. SG-400-007
. . . . . $475.00

Combination Sensor/Flange UHV Assemblies

We offer a variety of sensors welded to the feedthrough that eliminates the In-Vac cable required for standard sensor heads. This allows the bakeout temperature to be raised to 275ºC, although the actuator on shuttered heads is still limited to 100ºC max. the length of the sensor head to the feedthrough must be specified, along with any bends in the lines that you may require.



Ordering information

Single bakeable sensor/flange combo. SG-800-003. . . . $860.00
Single bakeable sensor/flange combo with pneumatic shutter.
SG-800-004. . . . . $1,890.00
Single right angle bakeable sensor/flange combo.
SG-920-001. . . . . $1,000.00

Accessories

Oscillators - Ordering information

Remote Oscillator. SG-900-004. . . . . $155.00
In Vacuum Oscillator provides long sensor life in adverse applications. SG-IVO-100. . . . . $495.00

Cables - Ordering information

30 inch in vacuum cable. Microdot connector each end. Teflon jacket, SG-900-001T. $80.00
30 inch in vacuum cable. Microdot connector each end. Silver braided, SG-900-001. . . . . $80.00
6 inch M/F BNC cable, connects feedthrough to remote oscillator module. SG-900-006. . . . . $40.00
10 foot M/M BNC cable connects remote oscillator to monitor/controller. SG-900-005. . . . . $40.00

Crystals

Gold crystals are suitable for most applications. Alloy may be more effective in dielectric applications.

Ordering information

Gold, 6MHz, pkg of 10 crystals. SG-900-003. . . . . $75.00
Silver, 6MHz, pkg of 10 crystals. SG-900-003S. . . . $75.00
Alloy, 6MHz pkg of 10 crystals. SG-900-003A. $75.00

Custom & Replacement Parts

0.5 inch, 1.25" Bolt Feedthroughs • Multi-Sensor Feedthroughs • NW-40 Flange • High Voltage Electrical • Welded, Brazed, Compression • Octal Electrical • UHV • Flex Tubing

All prices are quoted in United States Dollars, FOB our Guelph warehouse. Delivery is normally 1 to 2 weeks. Taxes are not included and will be charged extra. Terms are Net 30 days on approved credit.
We gladly accept American Express®, Visa®, and MasterCard®.

Founded in 1978,

PROTEUS INDUSTRIES

develops, manufactures, and markets a range of rugged and sensitive liquid flow switches, meters and sensors

Proteus Flow Meter and Flow Switch Selection Guide

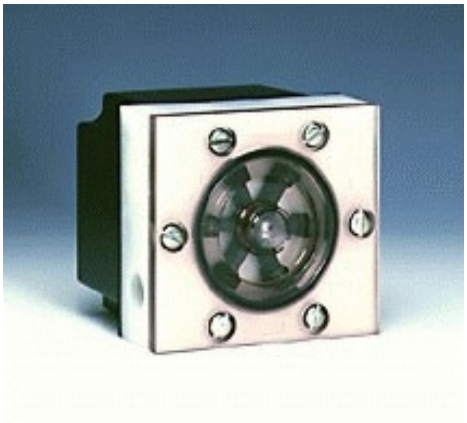
Product Family	Flow Switch	Metering Output					NEMA-4
		Voltage	20 mA	Pulse	Temp	Pressure	
100 Series	Yes						
200 Series	Yes	Yes*	Yes*				
500 Series	Yes	Yes					
700 Series		Yes*	Yes*		Option	Option	
800 Series	Yes	Yes					Option
PS600 Series				Yes			Custom
Customization							
300 Series	Reference only - not recommended for new designs						
100SP Series	Reference only - do not use for new designs						

*Specify either voltage or 4 - 20mA output when ordering

Overview (in specific relation to 100 series)

Proteus flow switches monitor cooling fluids or other liquid flows and trip an internal relay if the flow rate falls below an adjustable trip point. The relay may be used to shut down equipment or sound an alarm before damage is done to your equipment. Unlike pressure sensors, the proteus switch provides a true flow interlock. It cannot be fooled by downstream blockages that maintain pressure while stopping flow. The switch also differs from other flow switch designs because particle buildup cannot jam it in the flow ok position.

Proteus flow sensors use a turbine principle to generate a pulsed voltage that varies with flow. The output may be converted to flow rate by a proteus flow meter, or may be used directly by the customer. Magnets in alternate spokes of the rotor induce a voltage in a pickup coil when the flow turns the rotor. The voltage output varies in frequency and amplitude with the flow. The maximum frequency is approximately 100 hz, while the maximum amplitude is 500mv peak-to-peak.



100 Series

Sight flow indicators

How it works:
Fluid flowing through the switch spins a magnetic rotor to induce voltage in a coil. This voltage is measured by a simple electronic circuit which compares it to a user-set trip voltage. When the voltage is above the set point, a relay is held in its active position. If the voltage falls below the set point, or should the fluid stop flowing, the relay is switched off and triggers your alarm system. An active design combats the problem of particle buildup, which can jam many flow switches. Because the rotor is constantly spinning, it cleans itself of most buildup. In the very unlikely event that an object in the flow line did interfere with the rotor, the rotor will stop turning, and the switch will go to the alarm condition. This assures that when the switch shows fluid is flowing, there

is always flow through the switch.

Flow visibility
A clear polysulfone face plate displays the rotor to tell you at a glance if cooling water or other fluids are turned on. The speed of the rotor shows you the approximate rate of flow. When fluids with high temperatures and pressures are being monitored, a brass or stainless steel faceplate significantly extends the working range of metal flow switches.

Trip point
The trip point is set by adjusting an accessible through the rear of the electronics housing. The potentiometer can be adjusted without opening the electronics unit, and is in a recessed position so that it cannot be turned accidentally.

Electronic mounting
The switch comes with the electronics package mounted on the body of the switch. The electronics housing may be removed and mounted remotely when high temperature fluids are being circulated, or where there is limited space in which to install the flow switch.

Easy maintenance
The face plate may easily be removed to clean the flow chamber and rotor if necessary. No other maintenance is normally needed.

Fluid Vision™
700 Series

800 Series

100 Series Flow Switch - Active Design Assures Reliability	• Cannot jam in Flow OK Position • Models span 0.08 to 60 GPM • Adjustable Trip Point
200 Series Flow Meter- Analog Output Flow Sensor	• 0 -5 VDC and 4 - 20 mA outputs • Consider 500/800 series for new designs unless 4-20mA needed • Adjustable Relay Trip Point • Models span flow ranges form 0.08 to 60GPM, 0.3 to 230 LPM • Brass, polypropylene, Celcon™ and stainless steel versions • Direct Digital displays available
500 Series Metering Flow Switches™	• Flow rate from 0.15 to 4.5GPM, 0.6 to 17 LPM • Calibrated 0 - 5 volt output • Relay trip point - 16 preset settings • Compact design • Five Year Warranty • Customization available for OEMs
PS-600 Series - Pulsed Output Flow Sensor	• Flow rates from 0.06 to 60.0 GPM • 5 - 24 VDC pulsed output • Pressures up to 250 psi • Economical for cooling flow and process control • Visual flow indication
Fluidvision™ - Liquid Flow Rate, Temperature and Pressure Sensor and Switch (700 Series)	• Flow Rate from 0.08 to 60.0 GPM, 0.3 to 230 LPM • Temperature from -40°C to 125°C • Pressure up to 250 psi • 0 - 5 VDC or 4 - 20 mA outputs • Customisation available for Oem's • Relay trip point • Nema-4X Case coming soon
800 Series Metering Flow Switch™	• Flow Rate from 0.05 to 50.0 GPM, 0.2 to 190 LPM • NEMA-4X Case Available for reliable performance in rugged environments • Calibrated 0 - 5 volt output • Relay trip point • Compact design • Five Year Warranty • Customization available for OEM's

100 Series Flow Switches (all prices in Canadian, correct as of Jan. 1, 2008)

Connection Size	Flow Range	110V~AC 24V~DC	Celcon™	Polypropylene	Brass	Stainless Steel
1/4" FNPT	Selectable	AC	100C110 $247.50	100P110 $360	100B110 $337.50	100SS110 $480
		DC	100C24 $217.50	100P24 $330	100B24 $307.50	100SS24 $450
1/4" FNPT	0.1 - 1.0 GPM 0.4 - 1.0 L PM	AC	101C110 $255	101P110 360	101B110 $360	101SS110 $472.50
		DC	101C24 $225	101P24 $330	101B24 $292.50	101SS24 $442.50
1/4" FNPT	0.5 - 2.5 GPM 1.9 - 9.5 LPM	AC	105C110 $255	105P110 $360	105B110 $322.50	105SS110 $472.50
		DC	105C24 $225	105P24 $330	105B24 $292.50	105SS24 $442.50
1/4" FNPT	0.8 - 6.0 GPM 3 - 27 LPM	AC	103C110 $255	103P110 $360	103B110 $322.50	103SS110 $472.50
		DC	103C24 $225	103P24 $330	103B24 $292.50	103SS24 $442.50
1/4" FNPT	0.06 -0.6 GPM 0.2 - 1.9 LPM	AC	104C110 $262.50	104P110 $375	104B110 $345	104SS110 $525
		DC	104C24 $232.50	104P24 $345	104B24 $315	104SS24 $495
1/2" FNPT	1.5 - 12 GPM 6 - 45 LPM	AC	150C110 $247.50	150P110 $367.50	150B110 $337.50	150SS110 $472.50
		DC	150C24 $217.50	150P24 $337.50	150B24 $285	150SS24 $442.50
1/2" FNPT	4 - 20 GPM 15 - 75 LPM	AC	155C110 $247.50	155P110 $367.50	155B110 $337.50	155SS110 $472.50
		DC	155C24 $217.50	155P24 $337.50	155B24 $285	155SS24 $442.50
3/4" FNPT	6 - 30 GPM 22 - 110 LPM	AC	Use Polypropylene	160P110 $435	160B110 $360	160SS110 $720
		DC		160P24 $405	160B24 $330	160SS24 $690
1" FNPT	10 - 60 GPM 35 - 225 LPM	AC	Use Polypropylene	170P110 $570	170B110 $675	170SS110 $810
		DC		170P24 $540	170B24 $645	170SS24 $780

200 Series are sold with 0 - 5 V-DC or 4 - 20mA outputs with (1/4)" through 1"connection sizes and Celcon™, Polypropylene, Brass and Stainless Steel materials. 300 Series are available made in (1/4)" connection sizes, made from Celcon, Polypropylene, Brass and Stainless Steel materials. 500 Series parts are only made in Stainless Steel. PS600 Series parts are made in Celcon, Polypropylene, Brass and Stainless Steel. 700 Series are made with and without relay closure, with 0 - 5 VDC and 5 - 20 mA outputs and in Brass, Polypropylene, and Stainless Steel, although all combinations may not be possible. 800 Series also include SAE (only available in stainless steel) connection sizes, made in the same materials as the 700 series, as well as NEMA4 rated versions. Simple flow indicators are also available. We have a wide variety of 200, 500, PS 600, Fluid Vision™(700) and 800 Series products, so please contact us to find more information. Many accessories and options, including transducers and digital displays are available. It is also possible to customize your products, so please call Datacomp Electronic for more information about Proteus flow switches at our toll-free number or e-mail us at sales@datacompelectronics.ca.

PICOTEST M3500A 6½ DIGITAL MULTIMETER

Supports USBTMC

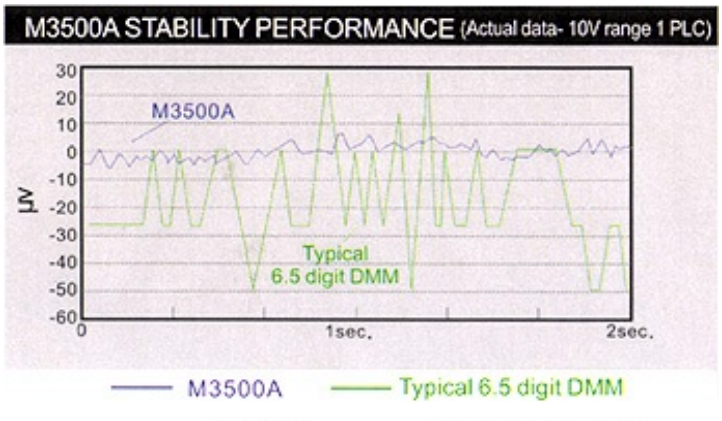
USBTMC stands for USB Test & Measurement Class. Any USB device conforms to USBTMC without the limitations of operation systems and environment can work under VISA assistance, and communicate with a computer. In other words, the control procedures via VISA to USBTMC device and via VISA to GPIB device are the same.

The advantage of using USBTMC with M3500A is that you dont have to buy any expensive GPIB module, and waste time to re-program the previous application software which is for GPIB. Only the instruments conform to USBTMC protocol in the VISA basis, and the version of NI-VISA 3.1 or upward driver is installed. The USBTMC unit under the original GPIB software will be recognized, and can be easily used. Besides, it also offers users other benefits, for example, support 127 DMM connections at a time, USB cord can work with a long distance application (at most 30M), and it is easy to get the cord.

USBTMC Application Note:
Before using USBTMC, please click into NI website (http://www.ni.com/visa) to download NI driver. After setting up M3500A application software, PT-TOOL & PT-LINK (enclosed in the CD), or your own programs, the M3500A will be controlled easily.

Stability, Speed and Accuracy

The 6½ digit M3500A DMM is designed with 7½ digit techniques to provide user a stable, faster and accurate measurement. The following figure is the stability performance comparison between the typical 6½ digit DMM and the M3500A .



High Speed:2000 Readings / Sec

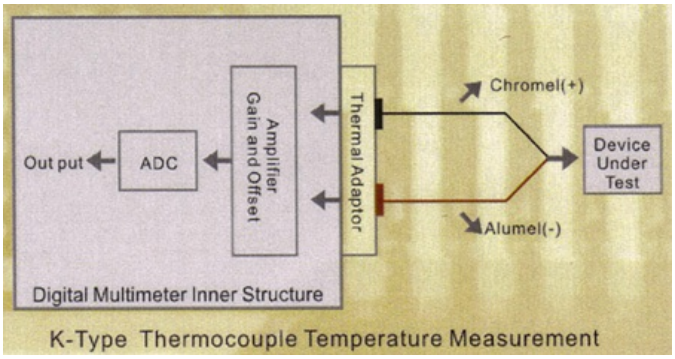
The M3500A is engineered with expertise to reach such a high performance: both of the sampling rate and the data transfer rate can achieve 2000 readings per second.

19 Full-Featured Functions

There are 11 measurements and 8 math functions : DCI, DCV, ACI, ACV, 2W?, 4W?, Frequency, Period, Diode Test, Continuity, Temperature, Limits, Ratio, MX+B, %, dB, dBm, Min/Max, and Null. In addition, Trigger and Memory functions are also involved. All functions above facilitate your measurement applications better.

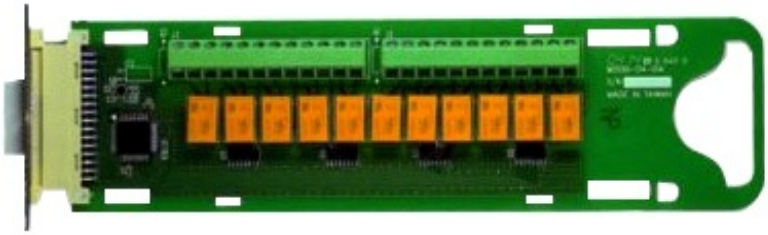
Temperature Measurements

Our thermal measurement functions support two types of measurements: Thermocouples and RTDs. For thermocouples, we support up to seven types of sensors: J, K, T, E, N, S and R, using a NIST Monograph 175 reference table. Moreover, for the RTDs temperature conversions, we adopt three types of standard: ITS-90, IEC751 and Callendar-Van Dusen standard in our thermal measurement functions. All these are made for user's convenience



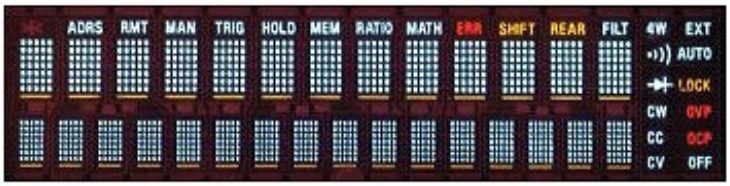
Multi-Point Scan

The M3500A supports up to 10 channels (2-pole) multi-point scan. For using this option, user needs to have an additional multi-point scanner card (Model M3500-opt01) The installation of the multi-point scanner card is very easy - just turn the power off and plug in the multi-point scanner card, and it is done!



Dual Displays with 3-Colour Annunciators

This model comes with a unique 5x7 dot matrix, VFD dual displays with three-colour annunciators. User can easily distinguish each symbols by their colours.



Noise Immunity

This model has an excellent performance on noise immunity. The core of this DMM is a powerful multi-slope analog to digital converter (A/D converter) This special A/D converter (p.s. patent is pending) helps the DMM to reach high-speed sampling rate, filters out most noise, and still keeps a good measurement linearity. In addition, to reduce the environmental background noise, we have added four sets of earth ground on the meter's front panel. And the

copper conductors inside the meter also contribute to reducing thermal EMFs.

Built-in USB Interface

The M3500A Series is equipped with a standard USB interface. This easy-to-use and hot plug-in USB interface has a high data-transfer rate over 2000 readings per second. It allows your DMM to reach a truly high speed, both internal sampling rate and I/O data rate, thus increase the measurement speed of your DMM.

Free Remote-Control Software:

The Remote-Control Software, PT-TOOL & PT-LINK, is free and easy for user's application. PT-TOOL is a stand-alone software which can imitate virtual M3500A operations on the PC, and allow users to transmit data in Excel format. In addition, PT-LINK under the Microsoft Word & Excel application provides users a simple function of getting values and diagrams.

Accessories Included:

CD (user manual and software applications), power cord, test leads, and USB cable.

Options:

Multi-point scanner card:M3500-opt01
Thermocouple Adapter:M3500-opt02
BNC to Banana Adapter:M3500-opt03
GPIB card:M3500-opt04
RTD Probe Adapter:M3500-opt05
RS232 card:M3500-opt06
Kelvin Probe:M3500-opt07
4-Wire Test Leads:M3500-opt08

Picotest Model M3500A Digital Multimeter - 6.5 Digits - Specifications

DC Characteristics [1]

Function	Range [2]	Resolution	Input Resistance	1 Year accuracy ± (% of reading+% of range) (23° C±5° C)
DC Voltage[3]	100.0000mV	0.1 uV	> 10GΩ	0.0050 + 0.0035
	1.000000 V	1.0 uV	> 10GΩ	0.0040 + 0.0007
	10.00000 V	10 uV	> 10GΩ	0.0035 + 0.0005
	100.0000 V	100 uV	10MΩ	0.0045 + 0.0006
	1000.000 V	1 uV	10MΩ	0.0045 + 0.0010
Function	**Range**	**Resolution**	**Shunt Resistance**	**1 Year accuracy ± (% of reading+% of range) (23° C±5° C)**
DCI (DC Current)	10.000000m	10 nA	5.1Ω	0.050 + 0.020
	100.00000m	100 nA	5.1Ω	0.050 + 0.005
	1.000000A	1 uA	0.1Ω	0.100 + 0.010
	3.00000A	10 uA	0.1Ω	0.120 + 0.020
Function	**Range**	**Resolution**	**Test Current**	**1 Year accuracy ± (% of reading+% of range) (23° C±5° C)**
Resistance [4]	100.0000 Ω	100 uΩ	1 mA	0.010 + 0.004
	1.000000 KΩ	1 mΩ	1 mA	0.010 + 0.001
	10.00000 KΩ	10 mΩ	100 uA	0.010 + 0.001
	100.0000 KΩ	100 mΩ	10 uA	0.010 + 0.001
	1.000000	1 Ω	5 uA	0.010 + 0.001
	10.00000MΩ	10 Ω	500 nA	0.040 + 0.001
	100.0000MΩ	100 Ω	500 nA||10 MΩ	0.800 + 0.010
Diode Test	1.0000V	10 uV	1mA	0.010 + 0.020
Continuity	1000.00KΩ	10 mΩ	1mA	0.010 + 0.030

Frequency and Period Characteristics [5]

Function	Range[6]	Frequency (Hz)	1 Year accuracy± (% of reading) (23° C±5° C)
Frequency & Period	100mV to 750V	3-5	0.10
		5-10	0.05
		10-40	0.03
		40-300K	0.01

AC Characteristics [7]

Function	Range[8]	Resolution	Frequency (Hz)	1 Year Accuracy ± (% of reading + % of range) (23° C±5° C)
ACV (AC TRMS Voltage)[9]	100.0000mV	0.1 uV	3-5	1.00 + 0.04
			5-10	0.35 + 0.04
			10-20K	0.06 + 0.04
			20-50K	0.12 + 0.05
			50K - 100K	0.60 + 0.08
			100K - 300K	4.00 + 0.50
	1.000000V To 750.000V	1.0 uV To 1mV	3-5	1.00 + 0.03
			5-10	0.35 + 0.03
			10-20K	0.06 + 0.03
			20-50K	0.12 + 0.05
			50K - 100K[10]	0.60 + 0.08
			100K - 300K	4.00 + 0.50
ACI (AC TRMS Current) [11]	1.000000A	1 uV	3-5	1.00 + 0.04
			5-10	0.30 + 0.04
			10-5K	0.10 + 0.04
	3.000000A	10 uV	3-5	1.10 + 0.06
			5-10	0.35 + 0.06
			10-5K	0.15 + 0.06

[1] Specifications are for 6 ½ digits and two hours warm up.
[2] 20% over range on all ranges except 1000Vdc and 3 A range.
[3] a. Using continuous integrating A/D converter.
b. Input bias current: less than 30 pA at 25° C.
c. Input protection: 100 V, all range.
[4] a. Specifications are for 4-wire ohms. For 2-wire ohms, use Math Null function
b. Max. Lead Resistance: 10% of range per lead for 100Ω and 1KΩ ranges; 1kΩ per lead for all other ranges.
c. Input protection: 1000 V, all ranges.
[5] Specifications are for 6 ½ digits and two hours warm up.
[6] 20% over range on all ranges except 750 Vac range.
[7] Specifications are for 6 ½ digits and two hours warm up, slow AC filter (3 Hz Bandwidth), sine wave input.
[8] 20% over range on all ranges except 750 Vac range.
[9] Specifications are for sine wave input>5% of range. When the inputs are from 1% to 5% of range and<50 KHz, add the additional error for 0.1% of range. For 50 KHz to 100 KHz, add 0.13% of range.
[10] 750Vac range is limited to 100 KHz.
[11] Specifications are for sine wave input>5% of range. When the inputs are from 1% to 5% of range and<50 KHz, add the additional error for 0.1% of range. For 50 KHz to 100 KHz, add 0.13% of range.